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FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 10 Number 3

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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Forest Service, Washington, D. C.

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Contents

FM RADIO EQUIPMENT FOR FORESTRY APPLICATIONS

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Engineer, Forest Service Radio Laboratory, Portland, Oreg.

Present Forest Service frequency modulated radio equipment operates in the 30- to 40-megacycle band. It may be divided into four general types, portable, lookout, mobile, and fixed station. Each of these has a definite use and all are required for a well-balanced network. The number of each type varies, of course, with local requirements. Some of the requirements to be considered are communications on fire lines, communications from fire line to fire camps, communications from fire camps to source of supply, lookout networks where telephone facilities are difficult to maintain, and aircraft activities. It is obvious that no system other than radio will successfully fulfill most of these needs, many of which require equipment of the most portable nature. It was for such reasons that the handy-talkie was given the highest priority on the laboratory development program.

Handy-talkie.—The handy-talkie is the smallest and lightest practical complete radiophone available to date. This general type of set was used extensively by the military forces where extreme portability was a requirement. It is a complete hand-held, self-contained portable radiophone. No accessories or additional equipment is necessary to place it in operation. To simplify operation, the functional controls have been reduced in number to the absolute minimum.

Two specific physical forms are available at the present time. One has the earphone and headphone attached as an integral part of the case and the entire unit is held in the hand for operation; the other employs a standard telephone type handset which is normally carried as part of the handle of the radiophone and detached when used. The antenna in the first unit is telescopic and, when not being used, is carried in clips on the side of the case. The other has a shorter antenna which is bent over and hooked to the opposite end of the case when not in use.

Both have two transmitting channels available, either of which may be selected by the operator. One channel is intended for communication between two similar units, or between a handy-talkie and a mobile set. The other channel is intended for communication with lookouts or with other stations through the medium of the lookout automatic repeater. Both may be used on single-frequency networks, but this arrangement is intended primarily for networks employing automatic repeaters.

Tower set.—The lookout or tower set has been mentioned separately from the other equipment since it has been designed to perform a special function, that of automatic repeating. The lookout or tower set is used primarily to furnish communications for the lookout or towerman and no function has been compromised to secure such service. However, it also provides automatic repeating facilities which are of

extreme value in radio networks employing handy-talkie type equipment.

The tower set consists physically of a basic unit, a control box, and a power supply. The basic unit contains the radio receiver, transmitters, and control relays, and is connected to the control box or control boxes by a multiwire remote-control cable. These controls may be located at distances up to 200 feet from the basic unit.

The use of a separate remote-control box, which has a maximum dimension of under 12 inches, permits installation of the basic equipment at any convenient location within 200 feet of the operating position. For example, where space is at a premium, as in a 7- by 7-foot lookout cab, the basic unit may be mounted in a shelter at the base of the tower and only the control box need to be installed in the tower cab. Where the towerman lives in a ground house, a second control box may also be installed in the living quarters. The radio equipment can then be operated from the tower or from the ground.

The power supply consists of dry batteries contained in wooden boxes located near the basic unit. Two boxes approximately 26 by 10 by 13 inches hold batteries capable of giving about 30 days' service when used continuously.

The Forest Service model (type TF) tower set is completely weatherproof, being housed in a cast magnesium case with all connections brought out through pressureproof fittings. It is intended to be left in place all year. The commercial model is much smaller and since all cables may be easily disconnected, it may be removed to a central shop or warehouse during the "off season." Functional controls are identical on both makes.

Application of two-channel transmitters.—To illustrate the practical use of two transmitting channels and a single receiving channel on all equipment, and also to illustrate the use of the automatic repeating function on the lookout set, we will use the following example:

A typical Forest network may consist of 4 or 5 radio-equipped lookout towers, 2 or 3 mobile sets, 6 to 10 handy-talkies, and a fixed station. The lookout sets will receive on 38 megacycles, which will be called the "Lookout" frequency or "Lookout" channel. The fixed station, mobile sets, and handy-talkies will receive on 36 megacycles which will be called the "Portable" frequency. All types of equipment in this hypothetical network will be equipped, by means of dual channel transmitters, to transmit on the "Portable" frequency or the "Lookout" frequency at the option of the operator. We will assume that one of the lookouts spots a suspicious dust cloud or smoke. He selects the "Lookout" transmitting channel and calls another lookout who may see the same smoke. They discuss the possibility of this being a reportable situation and the probable location of the smoke. As soon as a decision is reached, the individual initiating the action may immediately change to the other channel ("Portable") and make his report to the dispatcher at the fixed station. All of this preliminary conversation between the lookouts would not interfere with traffic being carried on between mobile, fixed station, or portable equipment since all such units would be using the "Portable" frequency while the lookouts used the "Lookout" frequency. This, in effect, makes two separate networks with immediate cross-tie available between all types of equipment.

We will assume, as a result of the report, a truck containing a mobile set was dispatched. As long as the truck was in the immediate vicinity of the dispatching station, the truck operator could talk to the station, but such range is usually short. As soon as the truck is far enough to be out of range of the station it must depend upon the lookout to repeat any instructions from the dispatcher. Verbal repeats are not only slow but in many cases result in confusion. It is at this point that the automatic repeating function of the lookout set becomes of value. By a mere flip of the switch the dispatcher may talk directly to the truck operator via the lookout repeater. To secure such operation it is necessary for the dispatcher to change his transmitter switch to the "Lookout" channel and request automatic repeat. He then calls the truck operator who, after switching to "Lookout" frequency, can carry on a two-way conversation with the dispatcher in the same manner as though he were talking directly to the dispatcher station.

After arriving at the fire, the truck and the handy-talkies may be used together without disturbing the lookouts by using the "Portable" frequency. However, the lookouts will be available, if within range, to any of the handy-talkies or the mobile set as soon as they switch to the "Lookout" frequency. In the same manner, any portable or mobile set may be called, if within range, by the lookout changing to "Portable" frequency.

Since only one receiving frequency is involved in any of these various types of equipment, it is impossible for the operator, through inattention or lack of instructions, to be listening on the wrong frequency.

The reliability of a radio network employing such equipment is accordingly increased in a large measure over any arrangement wherein the operator can select more than one receiving frequency.

Mobile.—Since Forest administration and protection requires a great deal of road travel time, mobile equipment is also important in forestry communication networks.

A wide selection of commercial mobile equipment is available for single-channel networks, but relatively few commercial sources can supply dual-channel transmitters without restricted channel spacing. The value of dual-channel mobile transmitting units is being recognized in the industry and more such equipment is becoming available. The application of such equipment was discussed in the preceding section.

Fixed station.—Fixed stations are those more or less permanently installed at any one location. They may be 110-volt powered, dry-battery powered, or they may be powered by some other source of energy such as storage batteries. 110 volts alternating current is to be desired as a power source because of its usual reliability and low operating cost. If power failures are frequent or voltage fluctuations are exceptionally severe, as may be encountered with a small local power plant, a storage battery system may be used. Where alternating current or storage battery power is not available or is not feasible because of installation costs, dry-battery powered equipment must be employed.

In many cases installations at ranger stations and supervisors' offices are at low elevations. This is a definite handicap where VHF is

used because of the limited operating range over low ground. In such cases consideration should be given to possible remote equipment locations on elevated points with remote control over telephone lines. Installing the equipment on an elevated point, within reasonable distance of the station, may result in an additional improvement, namely, getting the receiver out of local electrical noise and interference. Contrary to popular belief, noise does affect FM equipment, although not to the same extent it affects AM equipment.

Future equipment.—An additional equipment type contemplated for early development or commercial procurement is a pack set. This set will have about the same performance characteristics as the lookout or tower set but will be packaged for back-pack transportation.

The unit will incorporate a loudspeaker, have squelch or silent stand-by, and be generally suited for use by work crews who are to be kept "on call" for fire service.

Other applications for the unit will be to furnish temporary or secondary lookout communications, aircraft communications on a temporary installation basis, fire camp communications, temporary mobile service, and fire line communication for sector operations where one man may be assigned to carry the communication unit for one or more crews.

Dual transmitting channel equipment.—The following material catalogs the new series of FM radio equipment designed by the Forest Service or developed commercially especially for dual transmitter channel operations. Since single-channel mobile and station equipment and a limited selection of single-channel portable radiophones are available from a number of commercial sources, only dual transmitting channel equipment is included in this listing.

HANDY-TALKIE TYPE SF, MODEL B–2

(Forest Service)

The type SF, model B–2 handy-talkie is a frequency modulated two-channel transmitter and single-channel receiver designed for voice communication in the 30- to 40-megacycle band. Weight is 9 pounds; size, 4 by 6 by 14 inches high; length of antenna extended, 7 feet; length of flexible counterpoise, 4 feet.

The receiver is a single conversion superheterodyne operating on any predetermined frequency in the 30- to 40-megacycle band. Sensitivity is 60 decibels at 80 kilocycles. The intermediate frequency pass band is 40 kilocycles wide 3 decibels down.

The transmitter is composed of two complete channels employing phase modulation and capable of 15 kilocycles deviation on voice peaks. Power output is approximately 200 milliwatts. The two transmitters are on a separate chassis from the receiver and may be removed independently for servicing.

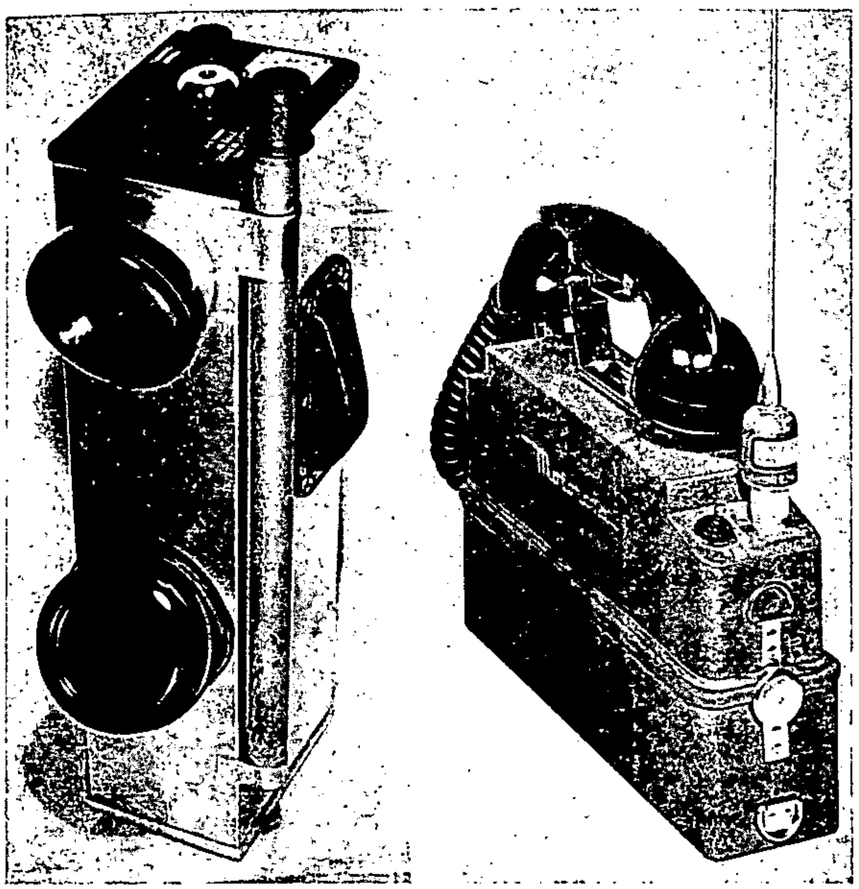
The range will depend almost entirely upon location. Two or three miles may be expected between similar units over flat terrain, but distances in excess of 50 miles are possible between elevated points such as mountain peaks.

The power supply consists of three standard flashlight cells and two miniature 45-volt "B" batteries. The two "B" batteries are connected

in parallel for the receiver and in series for the transmitter. The change in connections is made by the push-to-talk switch.

Receiver current drain is 400 milliamperes at 1½ volts and 10 milliamperes at 45 volts. Transmit current drain is 400 milliamperes at 1½ volts and 18 milliamperes at 90 volts.

Units produced after January 1949 are equipped with the necessary attachment fittings to permit the use of a separate antenna and special head set and close talking microphone for aircraft application.



Left, handie-talkie type SF, model B-2. Right, handie-talkie type FH2TR-1AL.

HANDY-TALKIE TYPE FH2TR–1AL

(Motorola)

The FH2TR–1AL handy-talkie is a two-channel transmitter and single-channel receiver of commercial design used for voice communication in the 29- to 39-megacycle band. Weight is 11½ pounds; size, 10 inches high by 12⅝ inches long by 3⅛ inches wide.

The receiver is a superheterodyne of cellular construction, each cell being a complete operating stage. Sensitivity is 0.5 microvolt for 20-decibel quieting. Selectivity is such that the attenuation is 40 decibels at 40 kilocycles and 80 decibels at 80 kilocycles. The audio output is 4 milliwatts into a 250-ohm load. Crystal control of the local oscillator is incorporated and the stability is within plus or minus 0.022 percent over a temperature range of −20° to +60° C.

The transmitter is composed of two complete channels which are also of cellular construction. Phase modulation is employed and the output deviation is plus and minus 15 kilocyles. The RF power output is 500 milliwatts. Frequency stability is plus or minus 2 kilocycles over the temperature range of −20° to +60° C.

The operating range between units, using the normal portable antenna, is 1 to 1½ miles over flat terrain. This range increases with elevation of the stations to distances in excess of 50 miles between mountain peaks. All ranges vary depending on local conditions of terrain, surrounding objects, and local noise conditions.

The power supply is composed of 4 standard flashlight cells and 3 miniature 67½-volt "B" batteries. Provision is made for 6 cells if longer life is desired. Battery life is 6 to 10 hours depending on transmitter usage.

Accessories are available for aircraft use and a special antenna is available for semiportable use.

The same unit may be secured with a single-channel transmitter only.

TOWER SET TYPE TF, MODEL A–T2–R

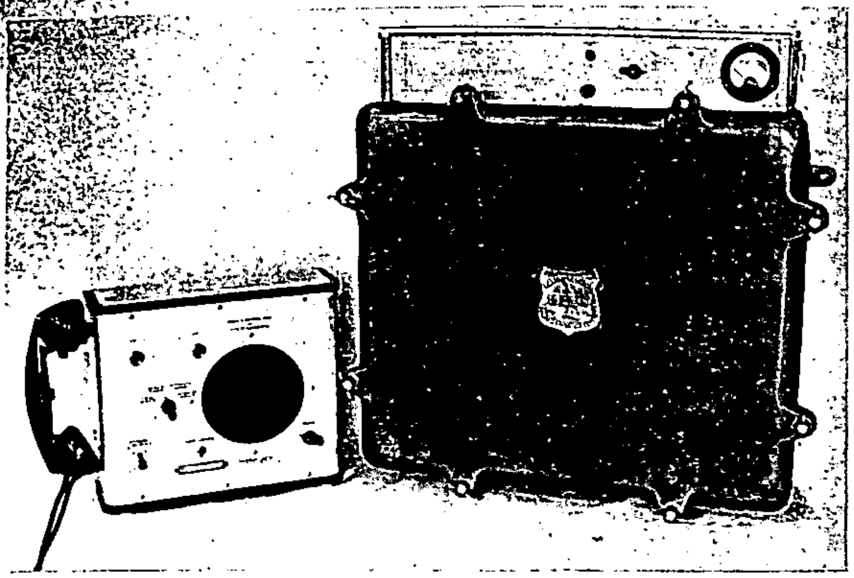
(Forest Service)

The type TF, model A–T2–R, is a frequency modulated two-channel transmitter and single receiver designed for voice communication and automatic repeating in the 30- to 40-megacycle band. It is dry-battery powered and intended primarily for use as a lookout or tower set. The transmitters and receiver are mounted in a weatherproof cast magnesium case and all leads to the control box, batteries, and antennas are brought out through pressureproof fittings. The equipment is operated from a control unit containing the loud-speaker, handset and hang-up box, volume control, and various switches. The control box may be located up to 200 feet from the basic unit.

Weight of basic unit is 51 pounds; weight of control unit, 9 pounds; size of basic unit, 24 inches wide by 23½ inches high by 10 inches deep; size of control box, 16 inches wide by 11 inches by 4½ inches deep, size of battery boxes (2), 26 by 10 by 13 inches high.

The receiver is a single conversion superheterodyne operating on any predetermined frequency in the 30- to 40-megacycle band. Sensitivity is better than 1 microvolt for 20-decibel quieting. The intermediate frequency amplifier band width is 40 kilocycles 3 decibels down. All connections are made to a terminal strip and the receiver may be removed from the case for testing or replacement without disturbing the other equipment.

The transmitter is a conventional frequency modulation transmitter employing balanced phase modulators and capable of 15 kilocycles



Tower set type TF, model A–T2–R.

deviation on voice peaks. Radio frequency power output is approximately 2 watts. The usual arrangement consists of two transmitters (in addition to the receiver and relay controls).

Automatic repeating or local control is secured by operation of a single switch on the control unit.

No definite range can be stated since this is a function of antenna height, location, and other local factors. Distances of 5 or 10 miles may be expected over flat ground with antennas at a height of 10 to 15 feet. Distances of a hundreds miles or more are possible from elevated points or mountain peaks.

Receiver current drain is 500 milliamperes at 1½ volts and 16 milliamperes at 50 volts with an additional 16 milliamperes at 135 volts when the auto system is used or when the squelch is "open."

The transmitter current drain is 500 milliamperes at 1½ volts and 50 milliamperes at 135 volts.

TOWER SET TYPE FHRT2TR1A1

(Motorola)

The type FHRT2TR1A1 tower set is a complete dry-battery operated radiophone and automatic repeater. The basic unit is housed in a stainless steel case approximately 10½ by 14 by 4 inches and will weigh 15 to 20 pounds less batteries. This set with specially designed boxes for packing two antennas, and the necessary batteries to provide 50 to 100 hours continuous service, will serve as a portable repeater for use on a large fire where repeater service is required and cannot be secured from existing fixed stations. It is of commercial manufacture produced from specifications developed by the Forest Service Radio Laboratory. The set consists of two basic units, a trans-

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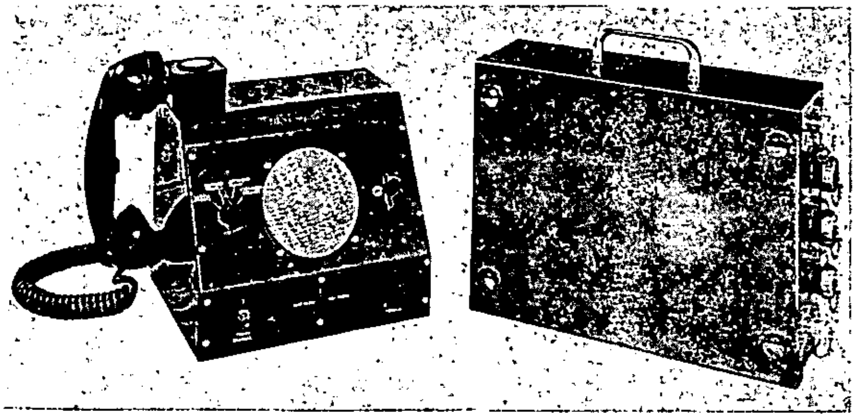


Tower set type FHRT2TR1A1.

mitter and receiver housed in a small metal case with the associated relays, and a control box containing the handset, speaker, and operating controls. An additional control unit may be connected to provide a second operating position. Power is supplied by dry batteries.

The receiver is a single conversion superheterodyne of cellular construction. Sensitivity is 0.5 microvolt for 20-decibel noise quieting. A squelch circuit is employed that controls the audio output and operates the transmitter control circuit for repeater operation. Selectivity is 40 kilocycles 40 decibels down and 80 kilocycles 80 decibels down. The receiver incorporates a stable crystal-controlled oscillator to furnish the injection voltage.

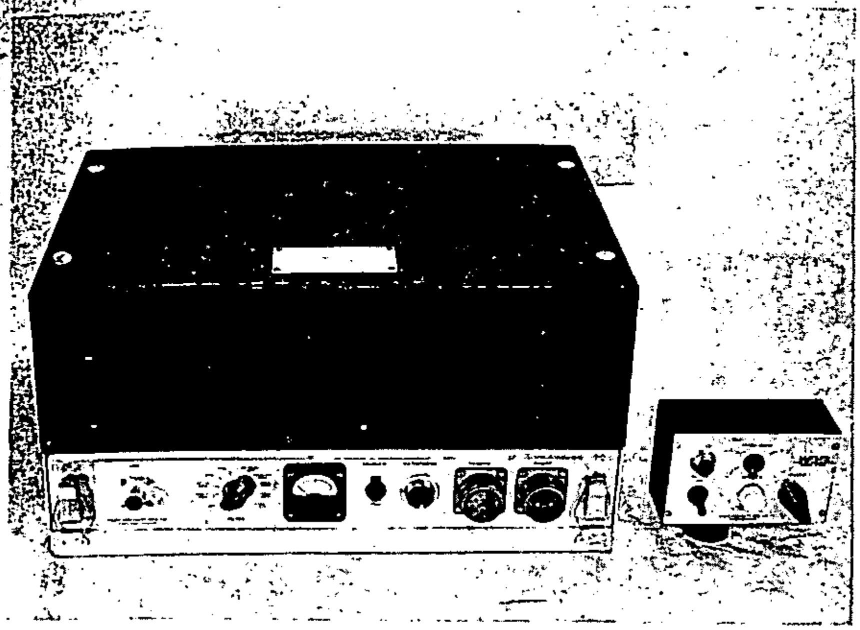
The transmitter consists of two complete channels employing phase modulation capable of 15 kilocycles deviation. Radio frequency power output is 1½ watts. Stability is within plus or minus 0.002 percent from −20° to +60° C.

MOBILE TYPE KF, MODEL A–T2–R

(Forest Service)

The Forest Service type KF, model A–T2–R is a complete mobile FM radiophone designed for operation in the 30- to 40-megacycle band and incorporates a two-channel transmitter and single-channel fixed-frequency receiver. The two-transmitter channels and the receiver with associated power supplies are mounted on one chassis and under one dustproof cover. Such construction makes a very compact unit. Since the receiver is fixed in frequency by a quartz crystal-controlled oscillator, no tuning is necessary by the operator and one major source of failure is avoided. The only controls necessary for operation of the unit are housed in a small box 3 by 4½ by 2 inches that may be conveniently located in the driver's compartment. The controls consist of an ON—OFF switch, speaker volume control, squelch adjustment, and transmitting channel selector switch.

The receiver is a double conversion superheterodyne operating on any predetermined frequency in the 30- to 40-megacycle band. Sensitivity is better than 0.5 microvolt for 20-decibel quieting. Positive noise compensated squelch is incorporated, the threshhold of which is



Mobile type KF, model A–T2–R.

adjustable at the operating position. The intermediate frequency amplifier bandwidth is 30 kilocycles 3 decibels down.

The transmitter is two channel, capable of 25 watts output on any two frequencies in the 30- to 40-megacycle band. Either frequency may be selected from the control box. A crystal-controlled radio frequency voltage is phase modulated and multiplied a total of 32 times to provide output with deviation capabilities of plus or minus 15 kilocycles.

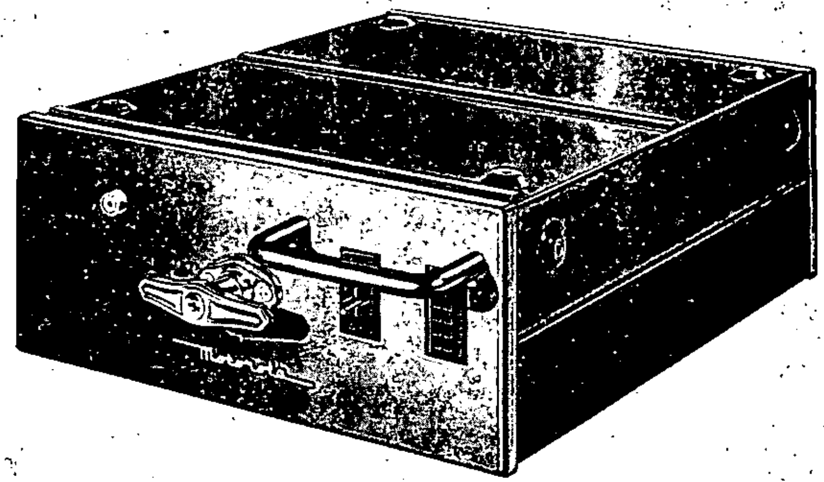
Accessories include speaker, control box, microphone, and cables. Weight is 60 pounds; size, 16½ inches wide by 8½ inches high by 15 inches deep; stand-by current drain, 12 amperes; transmit current drain, 22 amperes.

The range will vary considerably, depending upon the location of the two stations and the terrain over which communication is carried. It will vary from a few miles for two similar units communicating over flat ground to 50 miles or better from elevated points.

MOBILE TYPE FM2TR8OD(B)1SP1

(Motorola)

The type FM2TR8OD(B)1SP1 is a mobile radiophone of commercial design manufactured to operate in the 30- to 40-megacycle band. It incorporates a two-channel transmitter and a single-channel receiver designed for voice frequencies. Size is 6⅛ inches high by 21 inches wide by 20¼ inches long; stand-by current drain, 10 amperes; transmit current drain, 47 amperes.



Mobile type FM2TR8OD(B)1SP1.

The receiver is a superheterodyne having a sensitivity of 0.4 microvolt or less than 20-decibel quieting. Receiver-injection voltage is provided by a stable crystal-controlled local oscillator. Alternate channel selectivity is 85 decibels or better at 80 kilocycles.

The transmitter is composed of two separate channels capable of operating on any predetermined frequency in the 30- to 40-megacycle band. Phase modulation is employed and the deviation capability is 15 kilocycles. Instantaneous deviation control is incorporated in the modulator section. The radio frequency power output is 30 watts.

MOBILE TYPE 2164
(Link)

Transmitter mobile type 2164 is 8 inches by 10 inches by 12½ inches. Weight is 30 pounds; power output, 25 watts either channel. Receiver separate, same size as transmitter. Total stand-by current drain is 5¾ amperes; transmitter current drain, 23 amperes.

REGION 1 STRETCHER CARRIER PROVED IN AIR RESCUE OPERATION

H. K. Harris
Forester, Region 1, U. S. Forest Service

The latest model of the modified Stokes litter with wheel attachment, known as the stretcher carrier, developed for use of the Region 1 air rescue squad and described and illustrated in Fire Control Notes,[1] received its first real test last fall. It was used in the evacuation of a hunter who had been lost in the remote Selway River area of Idaho. When found, the hunter was so weakened by exposure and starvation that it was necessary to move him to a hospital as quickly as possible.

William C. Wood, parachute project foreman in charge of the air rescue squad reports the action. Excerpts from his interesting report follow:

On October 11, 1948, at 11:30 p. m., I was notified of a call to assist in the search of a lost hunter in the vicinity of Pettibone Creek on the Selway River. Because of the late hour and short notice. I was able to contact only eight men willing to go on the mission. Upon arriving at the parachute loft the next morning, I was informed that four additional men were available. Also available was Parachute Foreman Albert W. Cramer, who was to assist me in organization.

Flying in a C–47, we arrived over the jump spot at 10:30 a. m. and were on the ground with full equipment at 11:30 a. m. After a light lunch, the 10 men were lined out 20 to 30 feet apart between Cramer and myself. We contoured across the search area with Cramer blazing a line to the boundary of our area. We returned in the same manner except that Cramer followed his blaze back and I put in a new blaze line at the lower edge of the strip. This procedure was closely followed in our 2½ days of search.

Fortunately the lost hunter, a man 65 years old, was found Thursday night, October 14, 1948, by Ranger Jack Parsell and Alternate Side Poppe. He had been without food for 7 days.

Parsell was searching the creek bottom for tracks and Poppe was paralleling the creek at distances from 50 to 100 feet, when Parsell noticed a jumper streamer hanging in a bush. Three of our jumpers had left the orange signal streamer to facilitate finding their jump spot when they returned to retrieve their chutes. Parsell yelled "Hey, Sid, here's a jumper signal!" Immediately following Parsell's exclamation, Poppe heard a weak cry, "Hey!" Upon investigating, he discovered the lost hunter leaning against a tree about 20 feet from the edge of the creek, directly opposite the jumper streamer.

They covered the patient with their jackets and, while Parsell went for help, Poppe kindled a fire. Parsell reached camp at 5:30 p. m., just as our crew came in for supper. We immediately gathered a kapok bag, a cargo manta, and about 30 feet of cargo chute line for improvising a stretcher. A canteen of hot coffee and another of hot sugar water, an ax, and all available flashlights were also taken.

We reached the patient at 6:30 p. m. Exposure and starvation had weakened him considerably and because of violent trembling it was necessary to assist him in taking hot stimulants. While constructing the stretcher and administering first aid, I asked the patient if he had seen the orange jumper signal, and he

[1] H. K. Harris. Stretcher carrier. U. S. Forest Serv. Fire Control Notes 10 (1): 10–11, illus. 1949.

replied "Oh, is that what that was? I knew it didn't belong there, but I couldn't get over there to find out, so I just stayed here." Undoubtedly, the orange streamer played an important role in saving the man's life.

With the lost man on the pole and canvas litter, we reached the search camp at 8 p. m. A good thick mattress of pine boughs with a kapok bed made him quite comfortable. Canteens, improvised as hot-water bottles, were added to keep him warm. The patient's physician was contacted by radio at 9:30 p. m. and we were instructed to evacuate the patient as soon as possible. The modified Stoke's litter and wheel attachment were ordered for delivery by plane. The following morning, October 15, at 8:30 a. m., the stretcher and wheel were dropped.

By 9:30 a. m. camp was broken and the stretcher crew started out. One man guided the crew through logged-up sections of trail. It was soon learned that detouring for windfalls less than 4 feet high resulted in slowing the rate of progress. The best method was to have the guide limb the windfalls to the width of the trail, and the crew, upon encountering them, would lift the wheel stretcher over. Windfalls having a vertical clearance of at least 4 feet were limbed on the underneath side and the litter was wheeled under them. It was important to have the guide working well in advance of the crew to prevent the litter from being held up while clearing was accomplished.

Pettibone Creek was forded twice by merely adding extra men to the sides of the stretcher and sloshing through the shallowest portion of the ford.

On a good trail, level, or downhill grades, it was possible for two men to pull the stretcher at a fast dog-trot. Uphill grades were more tiring, but a good rate of speed was maintained by adding side men to assist the main bearers.

At least six stops were made on the trail to administer water and hot stimulants to the patient. Twenty minutes were spent feeding the patient at the Selway River.

We arrived at Shearer landing field, at 2 p. m. (It was estimated that it would require approximately 8 hours to evacuate the patient.) We had moved the patient from the Deep Saddle Trail on Pettibone Creek to Shearer landing field, a distance of 14 miles, 6 of which were badly logged-up, steep, and not maintained, in 4½ hours. With a conservative estimate of 1 hour spent in attending the patient, I believe we are justified in claiming the fastest evacuation of a litter patient ever effected in the mountainous terrain of Region 1.

We may have been in error in reporting that the Stokes litter was developed by the Army. It is used by both Army and Navy. Modifications for use on narrow, rocky trails, and transporting persons down steep slopes, over windfalls and through brush and timber was necessary to make it most effective for our work. This was a Forest Service development. Collapsible handles facilitate airplane transportation, and light tubing along each side strengthen the stretcher. The carrier wheel is detachable and may or may not be used, depending upon ground conditions. The unit is accordingly packed for dropping in two separate packages. There is little question but that speed and ease of operation is increased by the use of the wheel in open areas or along trails. (Detailed descriptions of all equipment, organization, and training of the Region 1 air rescue squad is being prepared as a chapter of the new Air Operations Handbook.)

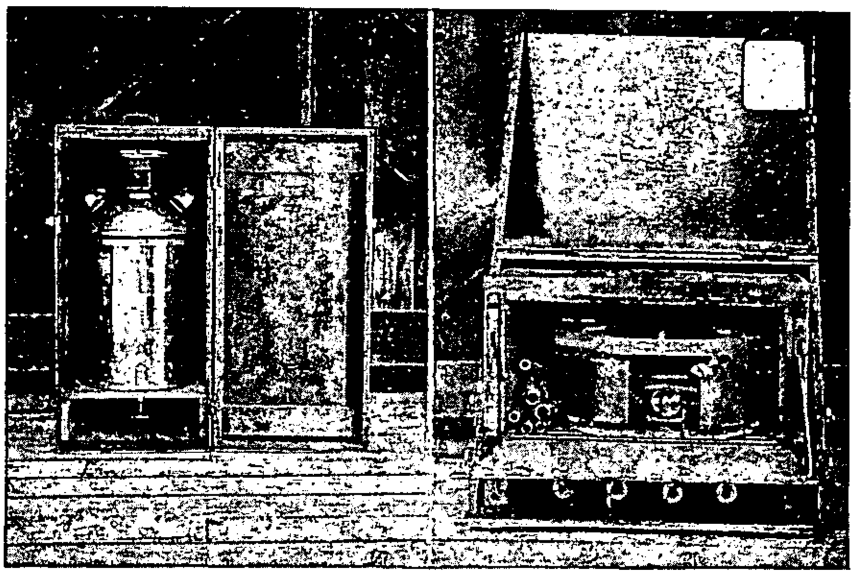
DUAL PURPOSE FIRE EQUIPMENT BOXES

Alvin Edwards
Storekeeper, Mendocino National Forest

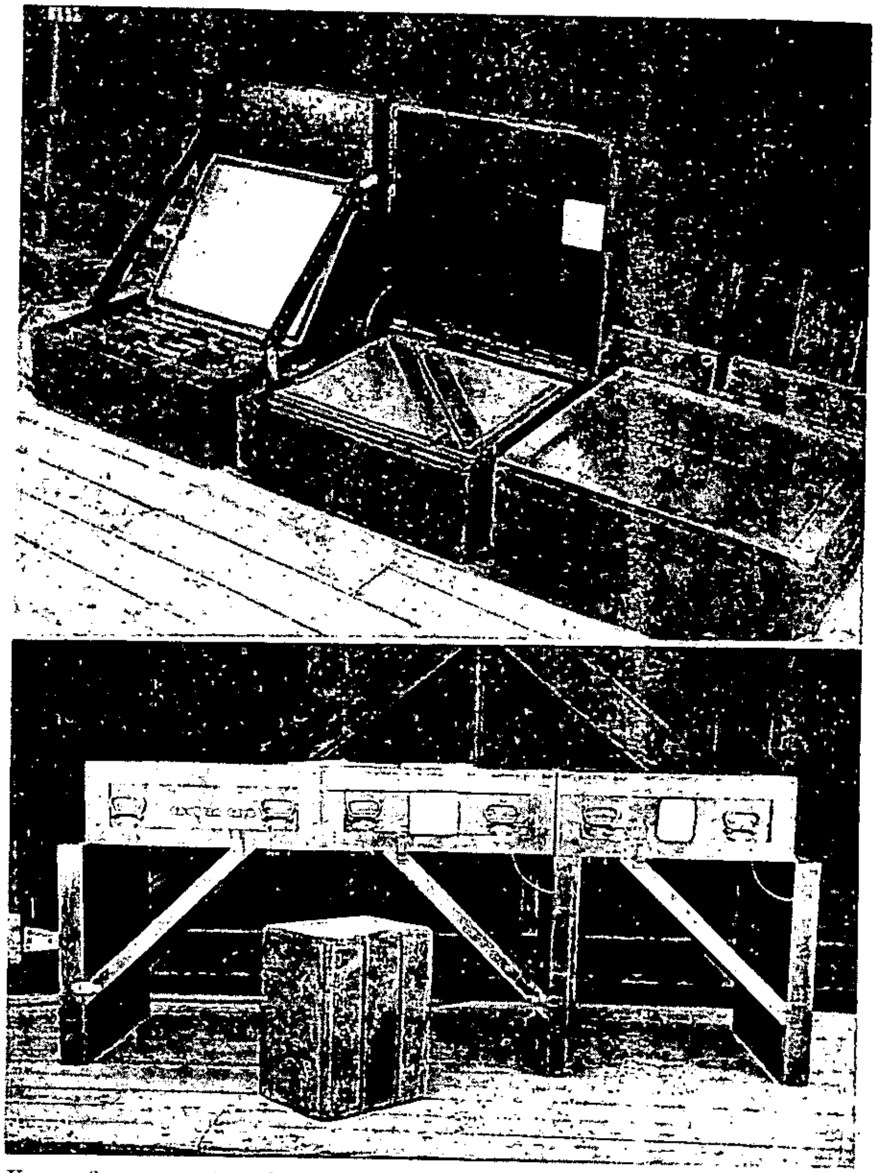
Some of the specialized fire camp equipment was difficult to transport without the possibility of damage or the scattering of some of the pieces. To prevent damage and to assemble complete outfits in containers special boxes were prepared. These boxes were also designed to serve a useful purpose in the fire camp. They were used during 1948 and found satisfactory for the purposes intended.

Hot or cold drink dispenser.—A self-closing spigot, sometimes called a restaurant water dispenser, was fitted to the bottom of a 10-gallon milk can and a box constructed to prevent breakage in transit. The dispenser sits securely on top of the box in the fire camp. The men can serve themselves by merely pushing their cups against the self-closing spigot.

Fire camp stove oven.—The box built for the fire camp stove oven also contains the hot-water stove, oven legs, and regulator. It was designed to serve as a radio desk in the fire camp. For that reason 1-inch pipe flanges were mounted to the bottom of the box on each corner so that 1-inch pipe legs could be quickly attached. The lid of the box can serve as a sunshade for the radio operator by being tilted forward and held in position by cord or chain between the two handles on one side near the top of the box.



Left, drink dispenser with self-closing spigot. *Right*, fire camp stove oven with oven door open to show hot-water stove and box legs.



Upper, fire camp stove boxes with braces in place, braces detached, and top down. *Lower*, the three boxes set up as a table.

Fire camp stoves.—Boxes were built for fire camp stoves and contain the stove burners, stove grill, a solid grill plate with grease troughs, and stove legs. By the use of special braces and short supports fastened with wing nuts two of the boxes can be converted into a table that may be used for any purpose needed in the fire camp. The third box increases the length of the table.

Portable generator and accessories.—Two boxes were designed to contain the portable generator and lighting cable. The one with the generator also carries fuel, grease, light bulbs, and servicing tools. The two cable reels in the other can be operated individually with the hand crank.

Left, generator with fuel, oil, bulbs, and tools. *Right*, lighting cable.

Fire Suppression at a "Profit" in Delaware.—For 1948, a number of States are able to boast of a good fire record because of the lowest number of fires, smallest average-size fire, lowest number or lowest percent of protected acres burned for any year since the beginning of organized fire protection. To this, State Forester Bill Taber of Delaware has added one more record which is doing a fire fighting job at an apparent profit.

This unusual situation was brought to light when State Forester Taber submitted his 1948 annual fire report. The report had not been completed because fire suppression costs showed a minus quantity. In other words, collection of suppression costs from individuals responsible for fires had exceeded actual 1948 suppression costs. This, of course, included fires occurring prior to 1948, but whose suppression collections were made in 1948. Bill apparently wasn't sure how to show the distribution of a minus quantity on the form and frankly, since it was something out of the usual, some thinking was done in the regional office before final action was taken.

Delaware has enjoyed a good fire record for a number of years. In these same years, Delaware's law enforcement record has shown a percent of convictions running from 76 to 100. Making it unprofitable to start a fire is one of the reasons behind Delaware's showing a "profit" in fire suppression.—EPHE M. OLLIVER, *Region 7, U. S. Forest Service.*

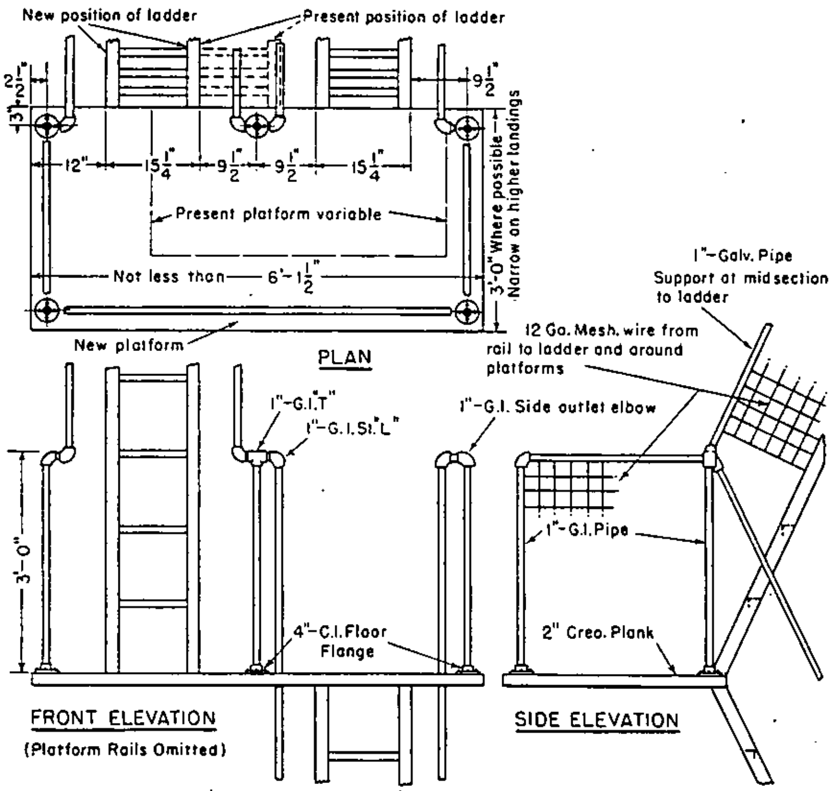
SAFETY LADDER FOR AN INSIDE LADDER TYPE TOWER

R. I. Lowndes, Jr.

Forest Engineer, Cherokee National Forest

The usual inside ladder type tower is probably one of the most difficult to climb, especially if tools, equipment, or other objects burden the climber. Certainly it is most dangerous, because of the very narrow, steep ladders and the narrow short platforms.

Towers of this type do not, ordinarily, possess sufficient strength in their structural design to carry the added weight and resistance to wind that replacement of the ladder by a stair would inflict on it. Also, the narrowness of the ladders, plus their closeness entering and leaving each platform, does not allow sufficient space to add handrails or similar supporting structure to be used as a frame for wire mesh.



Designed by: R.I.LOWNDES JR.

The platforms can be enlarged without changing the supporting members by overhanging the platform boards. A few additional anchor bolt holes will have to be drilled through the supporting members. The ladders can be separated one additional ladder width by using the present outside ladder stringer anchor bolt holes for inside ladder stringer anchor bolt holes at the bottom and top of alternate ladders.

One-inch galvanized iron pipe is amply strong for all railings and posts, and these will not endanger the stability of the tower by their added weight or wind resistance. This device (see drawing for details) is easily fabricated and installed by anyone with a knowledge of pipe fitting.

"Watermelon" Hose Roll.—Gathering up wet linen hose after use on a fire is one of the problems in forest fire fighting. Much of the new linen hose and particularly the treated forestry hose becomes unwieldy and difficult to manage. A small quantity may quickly fill a stake body truck before the job is barely begun.

At the Northeastern States forest fire equipment meeting in New Jersey in 1947, the Connecticut foresters put on a demonstration of rolling up wet hose.

A roll of hose takes shape.

The demonstration created sufficient interest to have it repeated again at the Fryeburg, Maine, equipment meeting in 1948. For those interested but unable to attend either meeting and because of the very limited distribution of the 1947 and 1948 reports, the following steps have been taken from the reports:

1. Wet hose is gathered up a length at a time by using a stick, piece of board, or straight pole 2 or 3 feet in length as a core.
2. After one complete wind of hose has been made, the core is turned at a 90° angle before making the next lap.
3. Turning and winding are repeated until the entire length is rolled.
4. The loose end is given a half hitch and the coupling is tucked under to prevent unwinding. After some practice, no rigid core or stick is necessary in making a neat pack job.—Edward Ritter, *Forester, Region 7, U. S. Forest Service.*

SAFE CARGO DROPPING

LAWRENCE J. SOHLER

Airplane Pilot, Region 6, U. S. Forest Service

The following is an attempt to bring out some of the important points in connection with cargo dropping, such as air speed, air resistance, force of gravity, airplane angle-of-attack.

When an airplane is flying at a reduced speed, the anchor fittings for the tail brace wires or struts may be about the same level as the cabin floor at the door. Since many types of airplanes are used for cargo dropping, some will even have these fittings below the floor level at reduced speed. These present the more critical arrangement. Airplanes, which have a high cruising speed or a comparatively low location of the horizontal tail surfaces, associated fittings, and brace wires or struts, may inherently present extra hazards for cargo dropping.

Force of gravity.—Any object regardless of size, shape, or weight will fall the same amount in a given length of time except as retarded by air resistance. For our purpose, air resistance which will reduce the rate of fall will not have to be considered because we are not concerned with the rate of fall for longer than 1½ seconds after the packages are released. One second after packages are released they will be falling at 32 feet per second or about 22 miles per hour. This speed is not enough to cause air resistance that will vary the rate of fall appreciably on any airplane cargo to be considered here.

At a rate of 90 miles per hour or 132 feet per second, an airplane will travel 8¼ feet in one-sixteenth of a second. That is the time it will take for the tail of some airplanes to get to the same place in space where the door was. An object will fall only ¾ inch in that length of time. Why, then, do not many packages strike the tail brace wires?

There are two reasons. One is because the packages are some distance from the side of the fuselage when the tail passes over them. Because of the angle at which the tail brace wires attach to the fuselage, the farther away from the fuselage the packages are when the tail passes over them, the better the clearance will be. The other and principal reason is the packages travel forward some in the direction the airplane is traveling, because of their momentum before the air resistance slows them down. The rate at which this forward travel is reduced depends upon the weight, shape, and size of the package. A light bulky package will travel forward only a short distance, and, therefore, will be passed by the airplane tail before it has much time to drop.

When cargo is only just pushed out of the door of an airplane, the elapsed time until the tail passes over it is the only figure needed to determine how far the package will be below the tail surfaces and

brace wires. One package can be considered to fall just as fast as another during the first second for our purpose. We assume no packages will be discharged which are so shaped that they will present a lifting surface and create any appreciable amount of lift due to the relative air speed.

We know that at 90 miles per hour it will require one-sixteenth of a second for the tail to pass the point in space where the door was when the cargo was pushed out. If a very light package is discharged, it will not travel forward far because of air resistance. A heavy package will overcome the air resistance and travel forward some. Because of this forward travel, the elapsed time will be greater before the tail passes over the package, and it is only this additional length of time that will cause it to be farther below the tail surfaces. If this amounts to one-half second, the tail will pass 4 feet over it; in 1 second it will be 16 feet above it, etc.

Attitude or position of airplanes in dropping.—Air speed should be decreased during the dropping operation to reduce the parachute opening shock and minimize the probability of tearing the parachute from the cargo package. Air resistance increases at the square of the air speed, and at 100 miles per hour it is twice as much as at 70 miles per hour. Since the air resistance is less at reduced speed, packages will travel forward farther relatively after being pushed out, and the elapsed time until the tail passes over them will be greater. However, by reducing the air speed the tail is lowered to increase the angle-of-attack to maintain level flight. Reducing the air speed on a fast airplane to 80 miles per hour will not make it as desirable for cargo dropping as one that normally flies at that speed. The tail will be kept lower and the packages will have farther to drop to clear it.

Difference in airplanes.—An appreciable difference between makes of airplanes will be found in the level of the cabin floor at the door and the horizontal stabilizers and their bracing wires or struts. Because a package or parachute may clear safely on one airplane does not hold that it will on another make. Airplanes having a high wing loading will of necessity have to be flown at a greater angle to maintain level flight at a given air speed.

Safety measures.—When packages are discharged they must be put out as low as possible and should be given a start in a downward direction. Packages must be prepared for dropping so that they will offer as little resistance as possible to insure at least a certain amount of forward travel after being discharged.

The above information indicates the necessity of being careful that no parachute ever gets out ahead of the cargo. Very light packages are dangerous and should not be dropped except when proper methods are employed. Packages that offer a wide flat surface may cause serious trouble if they are not properly discharged because the reaction of the air may cause them to rise rather than fall immediately after being discharged. One safety measure has been to modify the Region 5 Noorduyn and the three Region 6 Noorduyns to permit discharging the cargo through an opening in the floor in the rear section of the cabin. The intended purpose of this hatch is to obtain maximum clearance of the tail surfaces and brace wires with all cargo and parachutes being discharged. The seriousness of the cargo dropper's work should be given ample consideration by everyone connected with cargo dropping.

MISSOURI CONSTRUCTS WOOD TOWERS

George O. White

State Forester, Missouri Conservation Commission

In the early days of fire control work before the modern steel structures came into being, a considerable amount of ingenuity must have been demonstrated by Federal and State Foresters in constructing lookout towers. We learned this because the program of the Division of Forestry of the Missouri Conservation Commission, which started in 1938, was just nicely underway when steel was given a high priority for defense purposes and became practically unobtainable.

Constructing foundation for 60-foot wooden tower.

In addition to our inability to secure steel towers, our program operated on a very small budget and so we would hardly have been able to purchase modern towers even if they had been available. It is probable that most of the early wooden towers were made without detailed plans; at least none could be found to serve as guides for a struggling young forestry program.

Our district foresters used imagination in setting up temporary structures, most of which were very crude but served, temporarily at least, to find more fires than we could control. Now, by a process of evolution, we have developed a wooden tower which is quite satisfactory to our needs. It has enabled us to build up a good system of lookout towers, which we could not have done had we been forced to wait for steel and the funds to procure it.

At most of the State tower sites in Missouri, a 60-foot tower gives quite satisfactory coverage and the standard we have developed covers this height. Four poles of creosoted southern yellow pine, 60 feet in length, provide the legs; the stairway and braces are of untreated

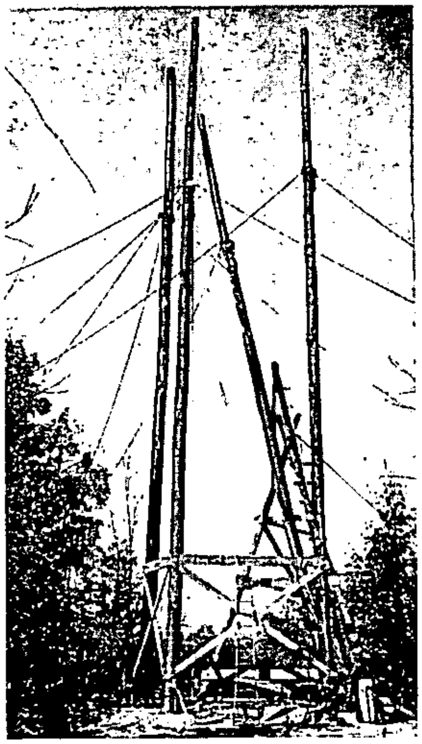
rough oak; and the cab is of finished lumber. The tower is designed to use braces and timbers, other than the legs, of not more than 16 feet in length so that native Missouri timber can be used. It is difficult to find portable mills cutting longer lengths here. We feel that the construction of this type of tower has resulted in a considerable saving and has made possible facilities that could not have otherwise been provided.

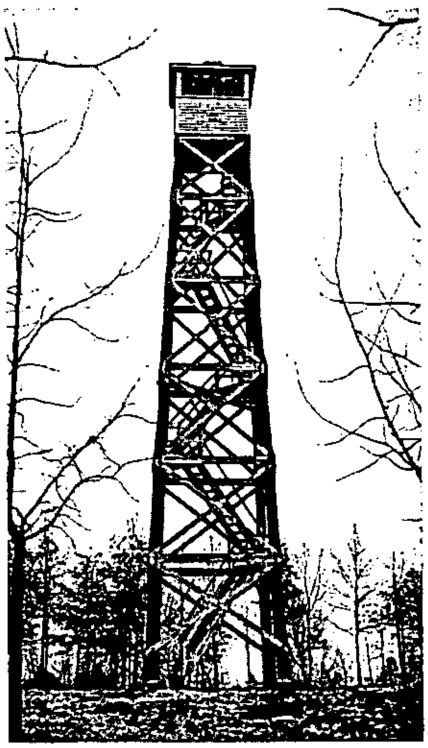
We have kept a careful record of expenditures on a number of these towers and although there is some variation in their costs, an average is about as follows:

Material	$1,000
Specially employed labor	850
Regular Commission employees (contributed time)	290
Use of Commission equipment	60
Total cost	2,200

Those of you who have constructed steel towers recently will be able to compare the cost with these wooden towers. It is understood that the steel alone in a 68-foot tower might cost close to $3,000 at present prices, not counting the cost of the foundation, plus labor of construction.

Of 51 towers operated by the Missouri Conservation Commission, 30 are wooden towers of approximately the same design as shown in the photographs.





Left, erecting fourth pole. Note the A-frame used to raise pole. Poles are prepared for braces prior to elevating them into position. Right, completed tower with exception of radio antenna and flagpole.

VEHICLE BRAKE TESTER

ARCADIA EQUIPMENT DEVELOPMENT CENTER

Region 5, U. S. Forest Service

The instrument described in this article has proved to be very useful in determining the adequacy of brakes on various loaded fire vehicles, and in training and testing vehicle drivers.—*Ed.*

The standard AAA brake tester has been a necessary piece of equipment for use in the Region 5 driver-training program, as well as for vehicle testing by the Arcadia Equipment Development Center. The double-barreled electrical detonating brake tester, which is a patented article, was obtained from the AAA at a cost of approximately $17. This unit allows driver reaction and vehicle braking distances to be measured separately.

The electrical detonating brake tester consists of the four units, brake-pedal switch, stopping-signal switch, interconnecting wiring, and detonator unit (fig. 1).

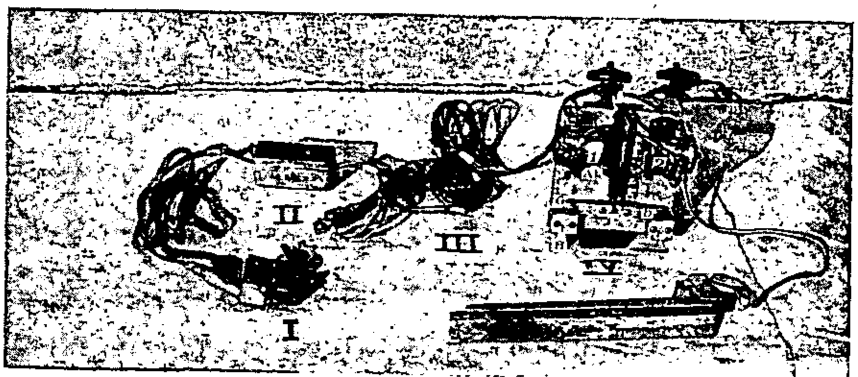


FIGURE 1.—AAA electrical detonator brake tester as modified by U. S. Forest Service: I, brake-pedal switch; II, stopping-signal switch; III, interconnecting wiring; IV, detonator unit.

As originally received, the AAA brake-testing unit had a strap attached at the top so that it could be hung over the running board by laying the strap on the floor of the car and then closing the door. For late-model passenger cars this method was satisfactory, but for the varying types of trucks, passenger cars, and other equipment to be checked, a different mount was needed. A clamp was designed for mounting the detonator on any type of bumper, running board, or other convenient part of the vehicle (fig. 2).

The detonator unit itself (fig. 3) consists of two magnetic switches (solenoids), two triggers, two hammers, and two blocks or barrels, each of which holds a blank cartridge and a piece of chalk.

Figure 3 shows the right hammer D having been fired, while left hammer C is ready to fire. Electric magnet 1 holds trigger A in a vertical position, which in turn holds spring-actuated hammer C in a cocked position. When the circuit is broken, hammer C strikes blank cartridge G, which expels chalk H onto the road surface, making a white mark.

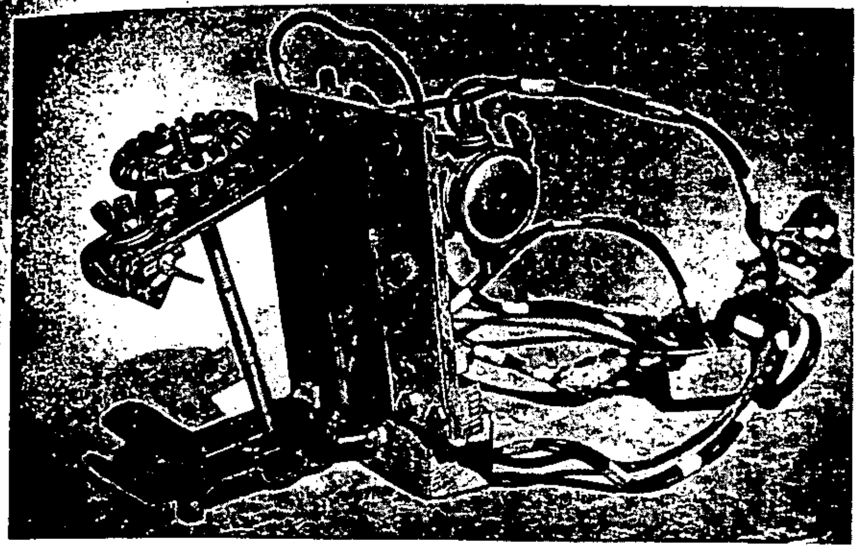


FIGURE 2.—Universal clamp mounting for brake tester.

As originally supplied, a mercury switch mounted in a small block of wood was attached to the brake pedal by means of a flat steel plate that went over the top of the brake pedal and two spring prongs that slipped under the pedal face. Since this system of mounting did not

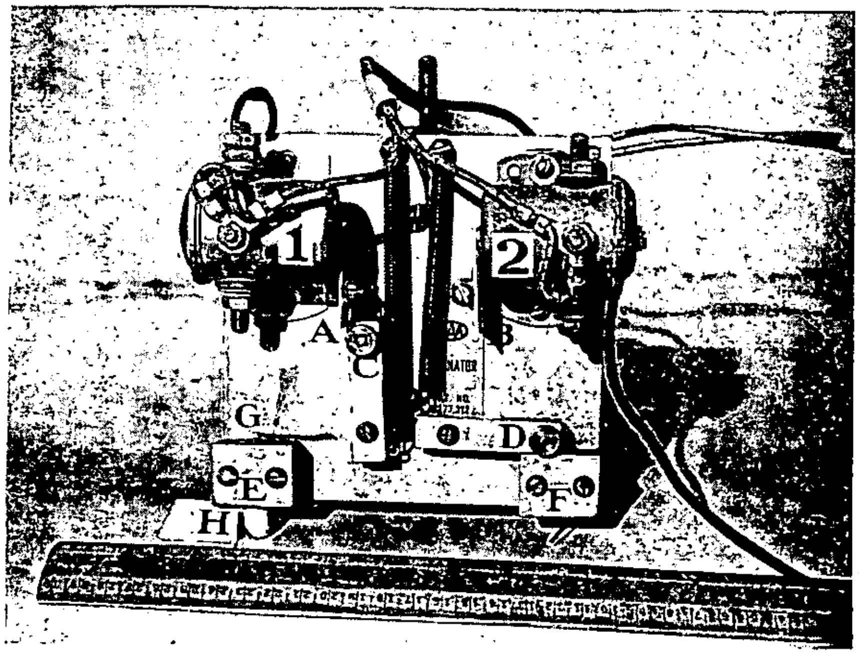


FIGURE 3.—Detonator unit of AAA brake tester: 1 and 2, Magnetic switches; A and B, triggers; C and D, hammers; E and F, blocks or barrels, each of which holds a blank cartridge (G) and a piece of chalk (H).

fit all the types of equipment that were to be tested, the switch was mounted on a small "C" clamp. This allowed for a more secure mounting of the switch on the shank of the brake pedal of all vehicle makes and models. In operation, the function of this mercury switch is to break the electrical circuit to the second magnetic switch, and thus place a mark on the pavement at the instant the brake is applied by the operator.

Originally, the stopping-signal switch controlled only the current to the first solenoid. Under this condition, once the detonator was set, it was imperative that the brake pedal *not* be touched by the operator until the test was under way. Otherwise, the misfire of No. 2 marker would void the particular test. To obviate this difficulty, the wiring was revised as shown in figure 4.

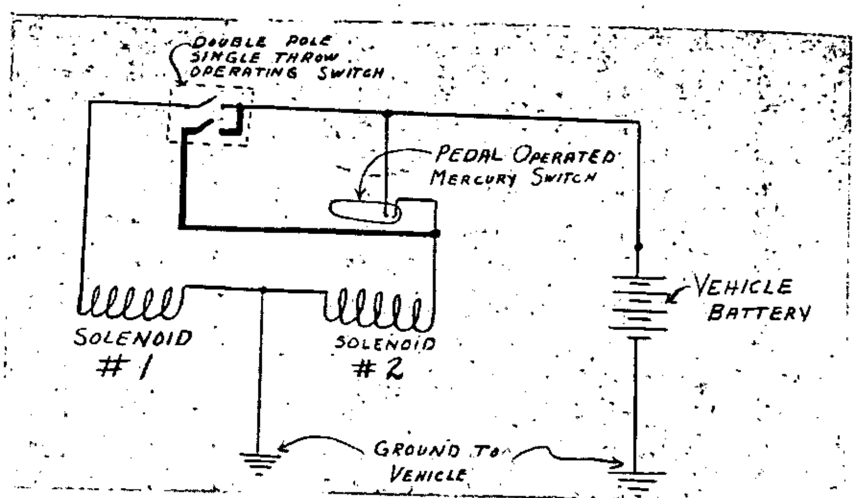


FIGURE 4.—Revised wiring diagram of AAA brake tester. Extra heavy lines denote the added wiring and switch pole that acts as a shunt around the pedal-operated switch until the stopping-signal switch fires number 1 solenoid and energizes the pedal mercury switch.

Wiring of the unit was increased in length for more convenient mounting of the equipment (fig. 5). The ground side of the solenoid connects through the ground wire and spring clip to any convenient grounded point on the frame of the vehicle. The hot wire is of sufficient length so that its spring clip can be connected either to the battery direct or to a "hot" terminal under the instrument board.

In operation, the unit works as follows: After the detonator is mounted, loaded, and set, the driver is instructed to drive along the level testing route at a stated speed. He is further instructed that as soon as he hears the blank cartridge fired he is to stop the vehicle immediately. When the vehicle comes to a full stop, he must hold it at that point and not allow it to roll forward or backward.

The test proceeds as follows: When the desired speed has been attained, the stopping-signal switch is thrown by the examiner, unknown to the driver. This fires the first blank cartridge, which signals driver to stop, and places a chalk mark on the road surface (*A* in

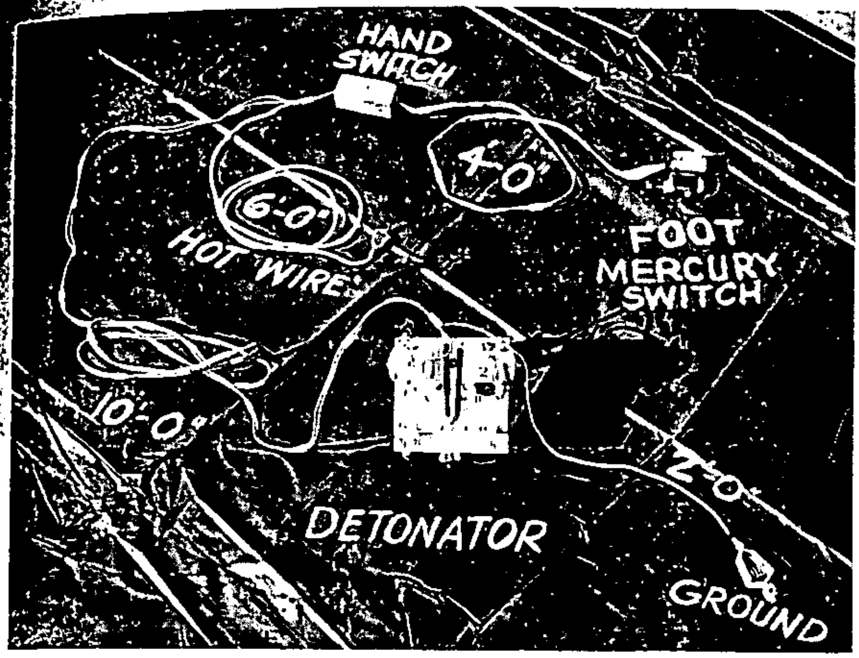


FIGURE 5.—Arrangement and length of wires.

fig. 6). As soon as the driver touches the brake pedal, the second cartridge fires and places the second chalk mark (*B*) on the road surface. When the vehicle is stopped, a chalk mark (*C*) is placed by hand directly under the position of the detonator unit. The reaction distance of the driver is measured between the chalk marks *A* and *B*.

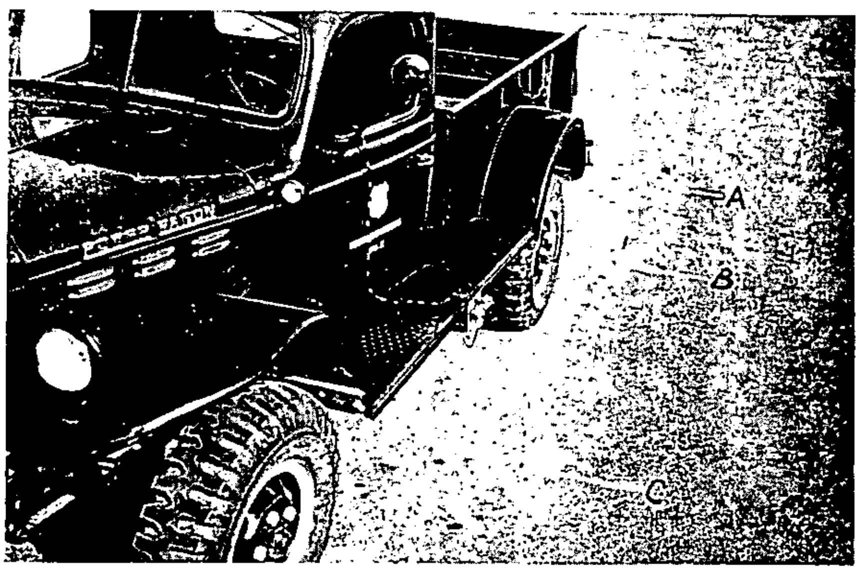


FIGURE 6.—Markings on pavement as made by AAA detonating type brake tester.

The braking distance of the vehicle is measured from chalk mark *B* to chalk mark *C*. Figure 6 shows one driver's marks for 10 miles per hour with the detonator mounted on the vehicle running board.

The following tables, taken from the AAA instruction manual, make it possible to convert the distances for 20, 30, or 40 miles per hour to reaction time in seconds and braking efficiency in percent.

TABLE 1.—*Reaction distance for three speeds by reaction time*

Reaction time (seconds)	Distance between chalk marks A and B, fig. 6, for speeds of—		
	20 miles per hour	30 miles per hour	40 miles per hour
	Feet	*Feet*	*Feet*
0. 1	2. 9	4. 4	5. 9
. 2	5. 9	8. 8	11. 7
. 3	8. 8	13. 2	17. 6
. 4	11. 7	17. 6	23. 5
. 5	14. 7	22. 0	29. 4
. 6	17. 6	26. 4	35. 2
[1] . 7	20. 5	30. 8	41. 1
[1] . 8	23. 5	35. 2	46. 9
. 9	26. 4	39. 6	52. 8
1. 0	29. 3	44. 0	58. 7
1. 1	32. 3	48. 4	64. 5
1. 2	35. 2	52. 8	70. 4
1. 3	38. 1	57. 2	76. 2
1. 4	41. 1	61. 6	82. 1
1. 5	44. 0	66. 0	88. 0

[1] Reaction time of average driver is 0.75 second.

TABLE 2.—*Braking distance for three speeds by braking efficiency percent*

Braking efficiency (percent)	Distance from chalk mark B to location of detonator, chalk mark C, fig. 6, for speeds of—		
	20 miles per hour	30 miles per hour	40 miles per hour
	Feet	*Feet*	*Feet*
10	133. 6	300. 6	534. 4
20	66. 8	150. 3	267. 2
30	44. 5	100. 2	178. 1
40	33. 4	75. 2	133. 6
[1] 50	26. 7	60. 1	106. 9
60	22. 3	50. 1	89. 1
70	19. 1	42. 9	76. 3
80	16. 7	37. 6	66. 8
90	14. 8	33. 4	59. 4
100	13. 4	30. 1	53. 4

[1] Minimum braking efficiency as allowed by Forest Service Safety Code, 1948, is approximately 50 percent.

This brake tester is an efficient and accurate unit in determining the braking performance of any motor vehicle, as well as definitely ascertaining the distance traveled during reaction time. It is recom-

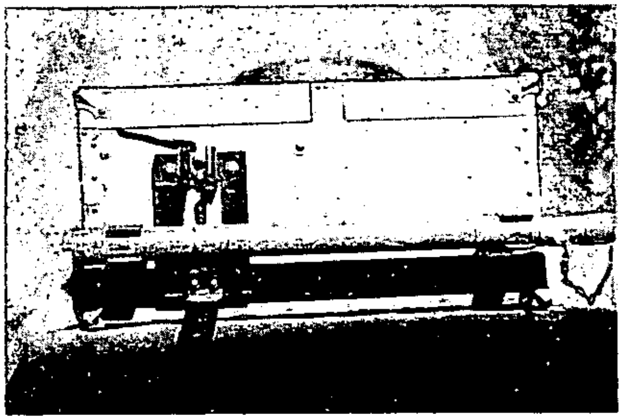
mended that this instrument be used as a regular part of any driver-training or equipment-testing program.

[Federal Government or Cooperative Forest Protection agencies interested in securing this brake tester with the necessary revisions, may purchase the original unit (approximately $17) from Traffic Engineering and Safety Department, American Automobile Association, Washington, D. C., and send it to Equipment Development Center, U. S. Forest Service, 701 North Santa Anita Drive, Arcadia, Calif., for alteration (approximate cost $8); or write for further detailed modification instructions.]

Type SX Radiophone Antenna.—Region 5 found the antenna set-up illustrated has increased usefulness of the type SX radiophone set manyfold, especially in fire line work where time and suitable antenna supports are at a premium.

The antenna proper is a war surplus item identified as a type AN-29-C telescopic antenna. It is approximately 13 feet long fully extended. The mounting and upright holding clips are salvaged pump holder clips from back-pack pumps.

The upright holding clips are mounted on a piece of canvas base Micarta insulating material ½ by 2½ by 4½ inches. One clip is mounted toward the top of the block and is electrically connected to the "ANT" post of the SX set. A



Antenna in carrying position.

bottom angle bracket is mounted on the lower side of the block. This lower angle bracket is made by sawing off one lip of a clip, the remaining lip being hammered straight and a ¼-inch hole drilled in it to accommodate the screw mounting stud on the bottom of the antenna proper.

The top clip and the bottom angle support are held on the Micarta block by ¾'' x 10-32 flat head countersunk machine screws. The block is fastened to the wood box by four 1'' x 10-32 truss head machine screws. The two end clips are mounted on the wood box with ½'' x 10-32 truss head machine screws. A suitable small metal reinforcing plate is also installed on the inside of the box opposite each clip.

Technical adjustment of the antenna loading capacitor within the set proper must be made before putting the antenna into operation.

There are slight electrical deficiencies as a result of mounting the antenna rod as shown; however, this is more than overcome by providing complete portability thus permitting the operator to quickly change locations.—Guy V. Wood, *Communications Engineer;* D. A. Galbraith, *Angeles Radio Technician;* and A. H. Schoss, *Stanislaus Radio Technician; Region 5, U. S. Forest Service.*

WE COMBAT FIRE THE COOPERATIVE WAY

J. Whitney Floyd

Chief Forester-Fire Warden, Utah

We've got a habit of long standing in the West. We cooperate. The custom probably grew out of the early experiences of the western pioneers. They had to get together and work together. Otherwise they stood to lose; livestock, household goods, or a scalp. Thus it was second nature for the third and fourth generation of westerners to cooperate in combating fire. Apparently there has always been cooperative action on fires in the State of Utah. But the action was most generally taken as a measure of self- or property-protection until organized fire protection became widespread.

The first opportunity for organized participation came when the Forest Fire Fighters Service was developed under the World War II Office of Civilian Defense. But this cooperation continued after the war emergency was over, and is resulting in an efficient fire organization for very little money. The efficiency and low cost are due to three primary factors.

(1) The cooperative plan reduces duplication of effort where two or more agencies are involved.

(2) The personnel and equipment of all agencies form a pool for common use in prevention, presuppression, and suppression activities.

(3) The cooperative plan appeals to the taxpayer because it demonstrates a united front by all levels of government.

The land ownership pattern of the State, and the nature of its fire control organization, will help the reader in understanding our problem, and our methods employed in its solution.

Utah is a public land State. Seventy-two percent of her total area is federally owned. The largest single Federal landowner is the United States Bureau of Land Management with some 24 million acres, followed by the United States Forest Service with nearly 8 million acres, the Indian Service with 2½ million acres, the National Park Service with 285 thousand acres, and the Soil Conservation Service, Bureau of Reclamation, and others administering a small acreage. The State Board of Forestry is responsible for 6 million acres of forest and watershed land owned by the State, counties, municipalities, and individuals.

Generally the national forest lands occupy the higher mountain areas and are solid blocks, but in a few instances there occur sections or half sections of alien lands. The United States Bureau of Land Management lands are interspersed with other Federal, State, or private lands. Most of the State lands were acquired by educational grants, at the rate of four sections (2, 16, 32, and 36) per township. These remain largely in their original ownership, and are scattered throughout the State, or if they have been sold to individuals

a checkerboard pattern of public and private lands exists. The result of these ownerships is a diversified pattern in many areas, or at least an intermingling of two, three, or more ownerships.

The State forest fire law places the fire responsibility on the county sheriff and his staff in the absence of a county fire department. The State Board of Forestry and Fire Control hires some temporary guards during the fire season, but the fire responsibility begins at the county level. Therefore, in the State we may have, in a given area, from two to seven responsible fire protection agencies, and this, without coordination and cooperation, could result in considerable expense, duplication, and lost effort in fire control activities.

With this situation throughout the State the primary land administering agencies expressed a desire to continue the cooperative working relationship built up during the war. The wartime organization was retained, but we called ourselves the "Utah Cooperative Fire Fighters." Our objective was to give the land in the State the greatest protection at least cost. Our organizational structure was a State committee headed by the State forester with representation from the major land agencies, and a smaller committee in each county, under what we chose to call a county coordinator.

The county coordinator may be a park ranger, a county sheriff, a county fire warden, a Bureau of Land Management district land manager, or a United States Forest Service district ranger. The county coordinator's responsibilities were to bring together all interested agencies on a county level. Each year the State committee outlines and sponsors a State-wide prevention program and training school, to be taken to the counties, or groups of counties. In this way the prevention materials and personnel are so correlated that we have eliminated duplication and intensified prevention.

The results of such a program have been gratifying. Several illustrations will demonstrate this. During 1947 many of the district graziers of the Bureau of Land Management were laid off because of insufficient appropriations. However, numerous fires were taken care of during this fire period by the Cooperative Fire Fighters in those areas, and their fire reports were mailed to the office of the State forester. In another case, the United States Bureau of Land Management had a large fire in Juab County which was threatening Indian land. A neighboring county, Tooele, rushed two fire trucks 140 miles, and they spent 2 days on the fire.

During the fire season of 1948 a lightning fire in Millard County grew to considerable size, burning over State, private, and Federal land. In this particular instance 305 men were quickly mobilized from the sparsely populated counties, and because of the training received through the Cooperative Fire Fighters plan they served as an effective fire force. A good illustration of economy in fire operation is reported in Summit County for the fire season of 1948. The State fire warden reports that 16 fires burned 2,373 acres, and the total suppression cost to the county was only slightly more than $100. The warden reports that this success and economy was due to the fact that the Utah Cooperative Fire Fighters had trained railroad crews, road and pipe-line construction crews, State road crews, and local ranchers before the fire season started, and these men were available on short notice for fire action.

An interesting phase of our 1948 State spring training program was the zone meetings for key personnel throughout the State. The major theme was law enforcement. The State attorney general's office detailed an attorney who explained the fire laws and law enforcement technique. This seemed to strengthen our State enforcement program for during the past year we had 22 prosecutions and 17 convictions. Only one of these cases was handled by the office of the State forester. The remainder were taken care of by local officers.

Suppression work has been simplified in many counties by the designation of fire suppression responsibilities through the local county committee. A typical example is in Millard County. The United States Forest Service was assigned a suppression boundary which did not necessarily conform to national forest boundaries. The United States Bureau of Land Management district grazier and the county sheriff were each assigned similar boundaries. None of the boundaries conformed to land ownership patterns but rather they circumscribed areas that were most easily seen, reached, and initially attacked by the respective group. Each agency assumed the responsibility of the first attack on fires within their assigned boundaries. The final cost of the fires was to be assigned to the agency owning the land burned. This system decreased detection time, reduced size of fires, and total cost.

Examples such as these have demonstrated to us the economy of cooperation. We intend to continue the system and develop new reserves of mutual assistance. It saves us money and resources.

Blanket Storage.—A heavy three-ply paper bag, similar to a cement sack, was recently put into trial use for packaging blankets at the Angeles Forest warehouse, in place of burlap covering. Ten folded blankets fit into the bag, which is securely closed at the top by two folds through which 8 to 10 Bostitch, Model No. P-2, staples are placed.

Advantages of this method of packaging over the burlap wrapping are as follows:

1. Cheap containers that are disposable. Burlap covering, when returned from project or fire, is always dirty, dusty, or full of foxtails and burrs. Cleaning of burlap is expensive in man-hours or laundry.
2. Time saved in packaging, requiring only one-fourth the time.
3. Containers are dustproof, mothproof, and somewhat rainproof. Burlap covering will allow dust to penetrate when blankets are in storage.
4. Package that will fit into helicopter cargo boxes and also into the automatic cargo release of a helicopter.
5. Package of proper size and shape for horse pack.
6. Package of proper weight for man pack, approximately 40 pounds.
7. Package which is easy to handle and to store.

Packaged blankets are stored in rows and numbered from bottom to top. When shipped from warehouse, the bundle bearing the largest number is shipped first. Thus, the total number of blankets remaining is indicated at all times (namely, the largest number, times 10).

The paper bags can be purchased locally at $211.40 per 1,000 in lots of 1,000, or $171.65 per 1,000 in lots of 5,000.

Specifications for bag are as follows: Size, 17 by 12½ by 48 inches; open mouth; three layers—50 substance paper; natural kraft, plain; bottom sewed.—Richard Gaspari, *Warehouse Superintendent, Angeles National Forest.*

KAMAS RANGER STATION FIRE TOOL STORAGE BOX

KENNETH O. MAUGHAN

District Ranger, Wasatch National Forest

Fire tool boxes of various designs are widely used throughout the Forest Service with the primary purpose of storing tools so they will be available for anyone needing them. The fire tool box shown makes a practical and well-built cache. It is constructed of the same type material, shingled, and painted to harmonize with the warehouse (white body, green roof), to which it is attached.

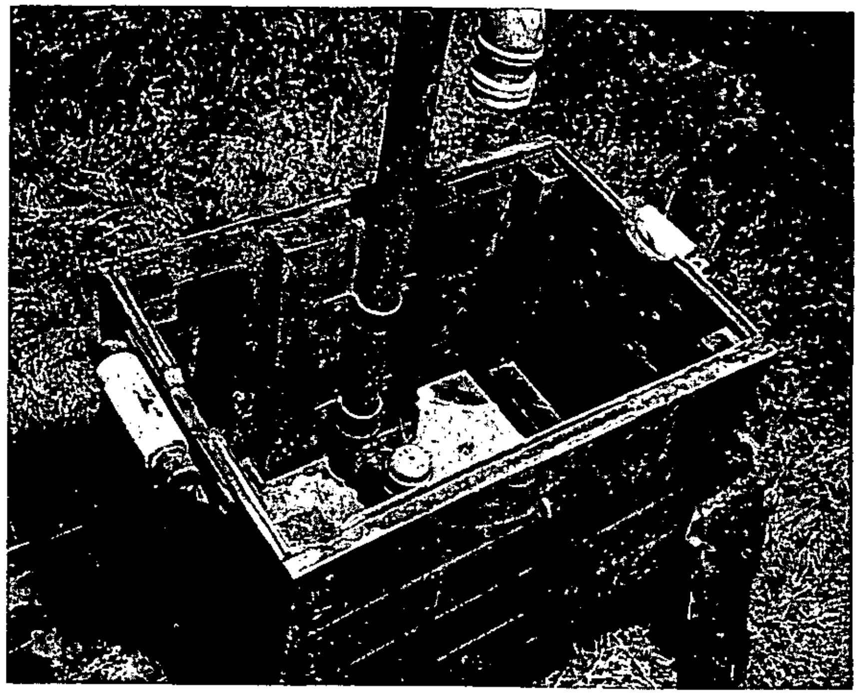
The box is 72 inches high to square, 40 inches wide and 17 inches deep. It is divided into two equal compartments. In one is placed a standard 5-man outfit, in the other a standard 10-man outfit. Tools such as Pulaskis, shovels, and axes are placed on a rack. Rations, files, waterbags, and other items making up the outfits go in the knapsacks.

Each compartment has a separate door, held closed by a simple wood catch. Regular fire seals connect ordinary fence staples driven into the door and into the division board between the two doors so that we may know when the tools have been used and service is required.

Two standard "Fire tool" black and yellow metal signs are used, one on either door to indicate contents of the two sections. The box is not placed on the ground, but is approximately 12 inches above the ground line. This prevents wood decay, makes it handy to get tools in and out, and facilitates keeping the inside of the box clean.

Connecticut Hose Washer.—The Connecticut hose washer was demonstrated at the New Jersey equipment meeting in 1947 and again at Fryeburg, Maine, in 1948. The construction of the washer is illustrated by the photograph.

A wooden frame with a sufficiently wide base is necessary to give stability. Top is hinged for opening to insert hose. Two rolls at front help to guide and flatten hose. Sometimes copper sheets are used as guides instead of rubber rolls. Pipe connections inside box are attached to two hand-made spray nozzles with ¼-inch orifices. These nozzles are set at a sufficient distance above and



Inner works of the Connecticut hose washer.

below line of hose to allow spread of water. Hose is fed through rolls (or copper sheets) between the two nozzles and pulled from opposite end toward drying rack. Generally, a set of bristle brushes is attached to the feed end of the box so that excess mud and dirt may be brushed off before hose enters box. The washer requires approximately ½ gallon of water per foot of hose at 50 pounds pressure to do a good job on dirty hose.—Edward Ritter, *Forester, Region 7, U. S. Forest Service.*

LAW ENFORCEMENT IN FIRE CONTROL ON THE CUMBERLAND NATIONAL FOREST

HENRY SIPE

Assistant Forest Supervisor, Cumberland National Forest

The history of forest fires on the Cumberland plateau is similar to that for many Southern States. Before the Cumberland National Forest was created, much of this area was burned over annually. Residents of Morehead, for example, say it was a common form of recreation after dark to drive out on the highways and watch the woods burn. In every community the older people still tell how the woods used to burn "every year." While this is probably an exaggeration, it is an undisputed fact that woods fires were a common occurrence.

Burning the woods in Kentucky was a custom handed down from father to son as being beneficial. It was supposed to green up the woods in early spring, kill snakes and ticks, and clear out the trash. Probably this practice stemmed from the setting of fires by the early settlers for clearing new ground, and eliminating hiding places for Indians. Whether these early practices were necessary or not, we know that they existed.

Such was the situation when the Cumberland National Forest was created in 1930. The first work was, of course, appraising values of lands and negotiating options for their purchase. Soon, however, Civilian Conservation Corps camps were established and fire control work got under way. Suppression was the first fire job done. During 1933 and 1934 no record of the number or size of fires was kept. Crews were sent to any and all fires and helped suppress them. In this way the idea became prevalent in places that the Civilian Conservation Corps would help farmers burn their debris—one hears this thought even now at rare intervals. Of course fire tower, telephone line, and road construction was begun. The enforcement of fire laws—and there were such laws, State and Federal—was not given much thought until 1936. A summary of all fires from 1935 to 1948, inclusive, shows the causes as follows:

	Fires	
Causes:	Number	Percent
Incendiary	717	30
Smokers	638	26
Debris burning	430	18
Miscellaneous [1]	255	10
Railroads	166	7
Campfires	111	5
Lumbering	47	2
Lightning	39	2
Total	2, 403	100

[1] Miscellaneous are chiefly smoking game out of trees, burning buildings or sparks therefrom, or children playing with matches.

One of the conclusions derived from the above figures is that the best way to reduce total area burned on the Cumberland was to *prevent* fires, as contrasted with a reduction in size of the average fire. There has been no significant change in the average area burned per fire in 14 years. This is primarily due to an average elapsed time up to attack of about 1½ hours. It includes discovery, reporting, dispatching, recruiting men, and travel to the fire. As long as we depend on a "volunteer" warden system backed up by a small core of year-long Forest Service personnel, we seem to be unable to reduce this elapsed time. Strangely enough, even during CCC years there was no substantial decrease in average area per fire.

The first fire prevention activity was probably the use of CCC patrolmen to contact local residents in 1934. These were continued until about 1937 when lookouts and wardens and other local employees were assigned the contact job. About 1943 contact work was given exclusively to lookouts or other regular employees, and this has continued up to now. In 1937 a movie project was set up and one man devoted full time to rural showings for a year or two. In recent years movies have been shown sporadically. For 6 months in 1938 a psychologist lived among the people of the forest, posing as a geologist, studying their attitudes and behavior as related to fires and to the general Forest Service program. Since 1936 most other known means of prevention have been used, such as personal contacts, posters, press releases, exhibits, leaflets, radio, and law enforcement.

Fire prevention efforts have borne fruit on the Cumberland. This effort can be divided into general education, hazard reduction, and law enforcement. Education which was begun in 1934 by CCC patrolmen, and enlarged by regular workers in later years, ran into strong adverse sentiment. Many folks were too set in their ways to stop burning the woods or too proud to admit they might have been wrong. It was hard to prove to them how fire prevention could mean dollars in their pockets. Results in the woods seemed too slow. Even today, when farmers are shown how to increase their tobacco income by priming (removing the lower leaves as they ripen before the upper leaves), some are still loath to accept the idea. Education is a slow process at best. And when children are not taught things in school, they will grow into adults faster than forest education can reach them. If parents are unsympathetic, children are inclined to be likewise.

Hazard education has accomplished a substantial decrease in number of fires only along a few railroads, and then only in years and sections when rights-of-way were well fireproofed by burning. This annual burning of sedge grass only makes the right-of-way more hazardous the next year. The Southern Railway is currently cooperating with us in an experiment where the right-of-way is mowed in the fall instead of being burned in early spring. Results have not been conclusive, but I still believe that some other way than burning must be found if the railroad fire problem is to be licked. An important factor is that about half the Southern's locomotives are now Diesels and the L. & N. has several Diesels.

In 1936 a legal assistant was employed on the supervisor's staff; his duty was to push law enforcement. Training schools were held for all regular employees and a law enforcement manual was issued. The objective was to investigate the cause of every fire and take action against the offender. Undoubtedly the bad fire season of 1936 stim-

ulated the law enforcement program, if indeed it did not provide the main urge to initiate such work. With only 2 cases initiated in 1935 out of 185 fires, it is obvious that no program existed prior to 1936. In 1936, out of 71 cases initiated, there were only 20 criminal cases concluded involving 31 persons. Of these, 13 paid fines or went to jail (total of 85 days) for failure to pay fines, and 18 had fines suspended. Only 10 cases were settled by collection of damages. This leaves 41 cases that were to a certain extent "duds." Indictment was refused or they were dismissed after initiation. Sixteen of these fourty-one were turned down by prosecuting officials. By present-day rules these 16 fires would not be listed as initiated. Fifty-one letters of warning were written to parties responsible beyond a reasonable doubt for causing fires. This practice of sending warning letters decreased until about 1942 when it was generally discontinued. Table 1 shows certain results of fire control work on the Cumberland since records were kept.

TABLE 1.—*Number of fires and area burned per million acres protected, fire day class, and law enforcement record, Cumberland National Forest, 1935–48*

Year	Per million acres protected		Fire day class			Law enforcement		
	Fires	Area burned	3	4	5	Actionable fires	Cases initiated[1] Civil	Cases initiated[1] Criminal
	Number	*Acres*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
1935	414	3,357	------	------	------	185	------	------
1936	1,081	19,335	------	------	------	467	------	------
1937	188	2,532	------	------	------	179	------	------
1938	205	1,671	------	------	------	193	------	------
1939	209	2,123	164	21	2	210	------	------
1940	318	4,173	132	17	------	321	------	------
1941	216	2,966	121	43	------	192	17	47
1942	129	2,082	53	26	------	126	30	53
1943	97	1,273	103	25	------	99	28	28
1944	78	1,351	83	17	------	82	28	17
1945	57	858	64	11	------	56	19	9
1946	136	2,009	54	16	1	131	19	24
1947	93	1,426	50	4	------	89	14	8
1948	79	848	63	5	------	76	15	5

[1] Cases initiated 1935–40 were not separated into civil and criminal. In 1935, 2 cases were initiated; 1936 71 cases; 1937, 31 cases; 1938, 39 cases; 1939, 40 cases; 1940, 46 cases.

Whether there was adequate preparation for the early law enforcement effort is a question. Although there was general prevention work, it may not have pointed up the probability of law enforcement soon to come. Every campaign to enforce a law must have advance publicity. For example, people need to know when the enforcement will begin, whether first offense penalties will be only a warning by the judge, whether the party responsible may pay the damages through settlement out of court, or whether suspects will be subject to criminal prosecution. All modern public relation methods need to be brought into play.

Forest officers in the early years faced many obstacles. In studying and overcoming them, guides have been established for meeting current situations and for training personnel. It was found that judges and prosecuting attorneys had to be interested in fire prevention and forest management activities. In addition, the voters who elect these officials had to be "sold." Interested judges will usually issue warrants; attorneys will allow witnesses to testify before grand juries; and sheriffs will serve warrants and subpoenas promptly.

Informed officials will see that docketed cases are not dropped or dismissed and that fines are paid, not suspended. Some judges have authority by law to suspend judgments (circuit judges in Kentucky), while others do not (county judges). When a replevin bond is given to pay a fine within a stated period, the cooperative judge will insist on its payment. A defendant will often plead "poverty," and a good judge will recognize that a fine or penalty within the defendant's means will insure that future fires that tend to make the poor poorer will be prevented.

Many fires on the Cumberland have been caused by juveniles. Juvenile judges will cooperate with forest rangers by placing juveniles on probation for a specified period, usually in the custody of the parent. The parent is really the one responsible, but of course cannot be prosecuted for an offense committed by the child. Judges sometimes require juveniles to erect fire prevention posters or write essays on conservation.

It is not essential that a case be "won" in order to accomplish good results. One example of this was a youth who set 17 or more fires along a road one afternoon; the evidence was quite clear. The court officials were not sold well enough in this instance to render prompt action. As the boy was to be inducted into the armed services, the landowner and forest officer secured the warrant and arrested the boy when he came to visit his girl friend. He made bond and slipped off to the recruiting center. However, the grand jury returned a true bill and the Army sent the boy back for trial. After the prosecutor outlined his evidence, the judge allowed a directed verdict of dismissal. There have been no fires in this area in the 5 or 6 years that have since elapsed.

Among the defenses that a defendant will set up, the forest officer must be alert to offset these: (*a*) he has a job promised to him, if he is acquitted; (*b*) he is the only source of dependence for an aged and helpless mother; (*c*) he is feeble-minded; (*d*) he didn't "abandon" the fire; (*e*) he "fit the fire" till he was exhausted.

Forest officers must assure themselves that needed witnesses will be at the trial, whether summoned legally or not. If your witness refuses to be sworn or to testify, trouble is brewing. One key witness was murdered before the trial.

The principles and cautions above outlined will be found to be helpful in Federal court cases as well as in State courts. The United States judge and attorney (or an assistant who handles your cases) are key individuals and should be well informed of the forest objectives. The marshal and his deputies can be of great aid in serving papers promptly.

It is essential of course that the law enforcement policy be clearly set forth and understood by all persons who are to place it in effect.

Many employees are as reluctant to participate in legal affairs as is the average citizen today.

One of the important parts of such a policy is to decide the degree to which cases will be initiated. By that I mean, shall cases be initiated only (*a*) where the party responsible is willing to plead guilty, or (*b*) where guilt is clear beyond a reasonable doubt, or (*c*) where there is some question of guilt. It is very desirable to have an "open and shut" plea of guilty case to initiate before a new judge. This allows him to become familiar with the law violated, the possible penalties, and renews his acquaintance with the investigator. After this, more and more difficult cases can be taken before the same judge with more assurance of receiving sympathetic consideration.

Some judges like to handle civil cases and do not like to decide criminal issues. In this event, a judge with concurrent jurisdiction elsewhere in the area may be located. This is true in Kentucky, where magistrates have equal jurisdiction with the county judge.

After an enforcement program has been started, it is essential that it be maintained at a steady and consistent level even though there is a change in personnel. Too often a new ranger will undo the work of several years of steady enforcement.

It is not necessary that all forest officers be highly trained specialists in law enforcement. Give men of reasonable intelligence some training, put the administrative urge behind them, keep up a sustained and persistent effort, and you have the essential elements of a successful program.

In 1942, representatives from important industries and utilities, as well as public employees of major resource agencies, were given training in Army camps to combat sabotage. This training was conducted by FBI personnel and other authorities in their respective fields. The Forest Service selected me as one of its representatives to go to Fort Oglethorpe, Ga., to receive training in such things as complaints, warrants, arrests, searches, investigational methods, various kinds of clues, sources of information, handling evidence, photography, ballistics, sabotage methods, court procedure, admissibility of evidence, and report writing.

Upon my return to the Cumberland, a 3-day training meeting was held at Cumberland Falls State Park for our forest rangers and guards, foresters from nearby forests, and State forest representatives. Most of the Fort Oglethorpe subjects were covered in abbreviated form.

This training stimulated the law enforcement work already begun in the spring of 1942 and resulted in more cases initiated and a good percentage of convictions. In the last year or two the records will indicate somewhat of a let-down. This can be traced to two factors. First, the fires are of the more difficult type to solve. Debris-burning fires—usually easy to solve—have just about disappeared. The bulk of the fires are now hunter, smoker, and incendiary fires—all tough ones. Secondly, it has been difficult to maintain an administrative urge. The war is over, "emergency" measures are not popular, and the timber sales activity is at a peak.

If the number of fires continues to stay below or close to 100 per year, the fire occurrence objective is being met. It is not denied that weather has been on the damp side in recent years. However, one cannot

travel in any part of the forest without being informed by local residents that fires are rare because "folks is a-skeered to let fires get away." (And I say "rare" because the risk on the Cumberland is tremendous. Thousands of people are in the woods much of the time.) Further questioning will usually bring forth the definite claim that the "woods is growing up a lot greener than it used to."

Forest administrators exhibit a wide variation in aptitude and desire when faced with law enforcement. Some just don't like to get into court; a few take to it naturally. Many of the characteristics of a good investigator are also qualities that make for general success in life. For example:

1. A righteous indignation against wrongdoing.
2. Common sense, good judgment, and tact.
3. Aggressiveness and persistence.
4. Resourcefulness.
5. Thoroughness.
6. Observing and good memory.
7. Technical skill and knowledge of the "modus operandi."
8. Familiarity with local customs, dialects, topography, and knowing the people themselves—for example, who lives where.
9. Ability to write a good report.
10. Intellectual honesty.

It is not entirely the fault of unit managers that their law enforcement records are sometimes pitifully poor. Their superiors often turn thumbs down on legal action for fear of stirring up trouble, political or otherwise. Perhaps just as important is the fact that foresters receive very little, if any, law enforcement training in college that would come anywhere near preparing them for the first major test of their professional career in fire control. I cannot agree that this is entirely an on-the-job training subject. I believe all forestry schools should include somewhere in their curricula at least the following subjects:

1. Qualities of good investigators.
2. Methods of investigation (observation and description, interrogation, surveillances, undercover work, and entrapment).
3. Laws and statutes.
4. Equipment used.
5. Clues: footprints, tire tracks, tool marks (especially axes), fingerprints, firearms—exploded shells, etc.
6. Marking, handling, and preserving evidence (for example, making plaster casts.
7. Complaints, warrants, arrests, bonds, summons.
8. Trial procedure.
9. Evidence in court (admissibility, witnesses, what must be proved).
10. Report writing.

It may be argued that it is the prosecuting attorney's duty to handle many of these details for you, and indeed it is. An investigator is likely to find, however, that an attorney who has not been "sold" on your work is more than likely to be on the defendant's side.

Perhaps some examples of the application of science to fire problems will emphasize my points. A bee tree was cut in Rockcastle County and plenty of ax chips were on the ground. The ranger visited the nearby residents, checked chips at woodpiles, tried axes, and soon came up with chips that matched. Considerable thought was evoked in the community, and although the case was not initiated in court for various reasons, few fires have occurred in that area since

then. The owner of the ax maintained his innocence, but everyone in that community knew who got that honey.

In another typical case ax chip marks were matched. The owner of the ax at first denied all knowledge of the affair, but soon admitted that two boys had borrowed his ax to cut down a chestnut tree to smoke out a squirrel. The boys owned up and paid damages.

To properly compare ax marks, chips should be taken from similar wood species and before the ax has been sharpened. Also chips must be taken with right and left hand swings, and with both edges if the ax is double-bitted. Every dent or gash in the edge of the blade will be visible on the top of the chip when it is held so the light throws shadows across the lines.

Occasionally unusual clues will be uncovered. One alert ranger, searching carefully, found a lock of singed hair caught on the root of a stump inside a burned area. Horse tracks led from here to a nearby farmhouse, where the animal was found. The owner admitted riding through the area but denied causing the fire. The ranger obtained a lock of the suspect's hair. Both locks were sent to the FBI laboratory, which replied that they were similar in every major respect. Confronted with this evidence, the suspect admitted he'd been drinking and had fallen off his horse, which ran home. He had then lighted a fire to warm himself; and, when it scorched him, he jumped up, bumped his head on the stump, and left without extinguishing the blaze. He paid a fine in county court.

The laboratory facilities of the FBI stand ready at all times to give expert opinions on all types of evidence. If requested, they will furnish an affidavit. In important cases they will send an expert to testify at the trial. Ordinarily they prefer to assist in field investigations only in incendiary cases and where Federal property is burned or threatened.

One technique every investigator should know is how to make plaster casts. These are valuable in cases involving footprints or tire tracks. Ordinary plaster of paris, obtainable at a drugstore, is sifted slowly into cool water until a thick cream is produced when stirred. This is poured carefully into the track and reinforced with sticks. It sets in 10 minutes or so. It can be removed and, when further dried and gently washed clear of dirt, reveals the track in detail.

Not far from Cumberland Falls tracks of two persons were found near several burned buildings. The fire had spread to the woods. Casts were made which later matched those of two suspects. There had been previous feuding in the vicinity. These parties were brought to trial in State court, but due to "technicalities" the case was lost. However, there have been no more fires in that area.

In the previous case a bloodhound was used to locate the persons who made the tracks. The Cumberland bought two bloodhounds in 1941. One was half foxhound, but could trail as well as the other. In any area where a concerted major effort must be made to curtail incendiarism, a bloodhound will pay for itself. Although easily handled, a dog requires considerable exercising.

In an area where numerous small fires are the rule, I believe it is unwise not to send an investigator either with or before the suppression crew. A crew usually destroys what few clues may have been left by the person who caused the fire; a few acres are saved, but the causative

agent goes unpunished and more fires occur. If a choice existed, it might be better to begin a law enforcement program a year in advance of a suppression organization. This might stimulate local residents to organize really volunteer crews with only nominal outside help.

The Cumberland has a net acquired area of 433,000 acres, but the Federal lands are highly checkerboarded. Thus it is necessary to protect some 524,000 acres of interspersed private holdings. Around the edge of the million-odd acres we protect are other private forest lands. Although a little of this is protected by the State of Kentucky, the majority receives no organized protection.

Undoubtedly the fire influence of the Cumberland National Forest extends beyond the million acres we protect. People are constantly moving from one area to another. This very fact, however, subjects the Cumberland to increased risk. Outsiders, who want to burn carelessly, move in and have to be "educated." Often the education begins only after they have allowed a fire to escape. Our "protective boundary" usually follows some road, stream, ridge, or county line. On adjacent unprotected land, people let fires escape with impunity. As 100-percent fire protection is approached, outsiders moving in will already have been exposed to fire prevention ideas.

It is my contention that every case well handled, regardless of whether it is won or lost—and by that I mean thoroughly and tactfully investigated and prosecuted—will in the long run reduce the number of forest fires.

COOPERATIVE FIRE SUPPRESSION ON THE NICOLET

E. W. Zimmerman

District Ranger, Nicolet National Forest

The district ranger muttered to himself as he turned off the county trunk road onto an old woods road. Why was it the spring fires always occurred in the back country when the side roads were practically impassable? The pickup pumper truck he was driving and his crew of five men could knock down most of the spring fires—if they could get to them soon enough. But that was the catch—after they left the main roads, they had to travel soft, slippery roads with high centers and panbusting boulders. He had requested a high-clearance, four-wheel-drive truck for just such conditions but those things take time.

Just ahead was a particularly bad looking piece of road. It was some distance to the fire and they had to get a lot closer if the pumper was going to be of any use to them. He gunned the motor and plunged into the mudhole. The truck slid to the side and promptly came to a stop as the rear wheels dropped into a deep rut. Sure enough, they were stuck. The crew jumped out and began to block up the wheels as the ranger gave the dispatcher a call on the radio and advised him of the situation.

After 30 minutes of hard work, they were able to get the truck through that mudhole and the one just beyond. The ranger was anxious. With this wind and all the elapsed time, they would without a doubt have a class C fire by the time they arrived. The old road turned and ran along side the railroad track and they could see the fire up ahead. This must be a railroad fire, but it seemed very small and certainly wasn't moving at the rate the ranger had expected. Luck must be with us, he thought, considering the excessive attack time we are very lucky indeed; but wait, there is a man working on the fire, beating it with a pine top—there's another man —and another—all beating at the fire with great vim and vigor.

The ranger and his crew jumped out to help the three-man crew already on the fire. In a few minutes the fire was under control. The area burned was small. The ranger knew these men, a local farmer and his two sons. They had seen the smoke from their east field where they were plowing and had cut straight across country to the fire which was not more than an acre in size when they arrived. They expected no compensation for their work as they felt they were protecting their own property as well as that of the Forest Service, and then too, they did not want to see that young plantation burn—the one the Forest Service planted some years ago about a quarter of a mile north.

The ranger was grateful because, as he looked over the surrounding area, he realized this fire could have developed rapidly and become a project fire if the farmer and his sons had not been close and had not taken immediate suppression action.

This free will initial action is typical of the cooperative fire suppression which takes place on many ranger districts every season. Yet, this extremely valuable form of cooperation can be greatly enlarged to the everlasting benefit and protection of our timberlands. Enlarging a program of this sort presents many difficulties and discouragements; not the least of which is the practice, created through necessity, of paying for all fire fighting work. We cannot avoid hiring men for fire suppression work, nor can we anticipate the complete and over-all control of fires by cooperators. To approach even this glorious ideal is more than we can expect from local people who have their own lives to lead. Then too, there are some who will ask, "What's in it for me?" Have we an answer which will satisfy these individuals? Lack of local settlers in critical areas limits the possibilities on some districts.

In spite of these and other unfavorable aspects, there must be ways and means of increasing the amount of cooperative fire suppression. It would seem that we should lay the ground work in advance—that we should make a particular effort to build good will among the settlers in isolated areas. Here again we face obstacles; district personnel is subject to frequent transfer and, to a lesser extent, settlers move from critical areas and new people move in.

The proposed good-will program involves time, effort, and education. Ours is the task of convincing the district residents that they have enough at stake to justify their taking time to put out small fires. We have come a long way in our program of showing people they have enough at stake to *prevent* fires; now we must ask them to go a step further. Cooperators gain a source of satisfaction from doing a service to the community. Our job is to foster and develop this feeling and to see that these individuals gain recognition for this service. The task is not simple. The human struggle for the material things of life does not parallel our purpose, nor can we develop an efficient corps of cooperators overnight, but the ultimate goal is well worth striving for.

AIRCRAFT IN FOREST FIRE CONTROL IN NEW YORK[1]

F. C. McLane

New York State Conservation Department

Someone said once that "Time is the essence and custodian of all experience." Time, relatively speaking, is just as important a factor to the business of forest fire control as it is to our daily lives. In this forest fire control business we have formulas for calculating the rate of spread of a fire; for calculating its probabilities; for calculating the number of men needed to check its advance in a given period; for estimating the damage done; and for many other things. We have factors and equations entering into problems of fire behavior; methods of attack; fire line construction, mechanical and otherwise; etc.—all necessary to do the best possible fire suppression job. But when it comes down to the final analysis, the result of our work, whether good or bad, is dependent primarily on time.

Naturally, then, the speed and accuracy with which we do things has a definite bearing on the conservation of the time element. Specifically, the modern plan of forest fire control is founded on speed. It is designated to reduce, insofar as possible, the most dangerous factor: lapsed time—the interval between the inception of a fire and the time that actual suppression measures may be undertaken. To reduce this time to a minimum, we must be constantly on the alert to develop and adopt new techniques and equipment, and to devise suitable and efficient ways to use them. The struggle against lapsed time begins with the prompt and accurate detection and reporting of a forest fire, and is followed up by promptness in dispatching fire suppression crews and equipment to the scene of the fire.

Many new devices have been adapted to modern forest fire suppression and great advances have been made in the development of forest fire control equipment in the past decade. One of these time-saving developments is aircraft.

We purchased our first airplane back in 1931, and since then we have used our aircraft to what we believe to be the best possible advantage, amassing nearly 15,000 of the roughest, toughest, and nastiest flying hours. Flying was done under all conditions and, up to 2½ years ago, with one, single-engine airplane that was replaced periodically. We feel justified, also, in being proud of our safety record.

The first airplane was used in systematic patrol for the detection of forest fires. The initial patrols were made in a fire control district lying southeast of the Catskills and at the back door of Metropolitan New York City, because the detection system there was inadequate, and nearly 25 percent of all the forest fires in the State were occurring there at that time.

[1] Condensed from paper presented at a meeting of State fire protection officers, Bearbrook State Park, N. H., March 17, 1949.

The results of the first year were encouraging. It became increasingly evident that aircraft had possibilities of fitting into any situation where time, distance, or transport entered the equation. But its use was definitely limited because of lack of air-to-ground communications. This missing link was supplied in the following year, 1932, by the installation of two-way radio. With each ensuing year, the airplane achieved greater success in the reduction of fire losses. As our airplane was replaced from time to time by new and improved types, new uses were developed. Most of these developments were spectacular at first. Today, aircraft has become one of the most effective tools in the hands of our forest fire control organization. It fits solidly into our plans and is a definite "must" if we are to keep abreast of modern fire control developments.

We don't know all the answers to our fire control aviation problems. On the other hand, we feel that in 18 years of using aircraft in forest fire control we have acquired a background of considerable experience in the application of aircraft. What we have determined to our own satisfaction is—

1. That we have only scratched the surface, as far as the use of aircraft is concerned.
2. That there is plenty to be accomplished.
3. That certain, specific types of aircraft are more adaptable for certain assignments than others.
4. That no one piece of aircraft equipment available on the commercial market today is ideal for meeting the variety of complex fire problems we have to cope with in New York State.
5. That the airplane is a fast and adaptable piece of machinery, necessary for effective forest fire control.

What have we done with our aircraft, in these 18 years of operation, that has made it such an important cog in our forest fire control machinery? These activities fall into nearly every phase of forest fire control including prevention, presuppression, detection, reporting, suppression, scouting, and the estimating of burned areas and damage. Suppose we make a quick analysis of each of these seven phases.

Prevention.—The airplane has a definite psychological value in the areas in which it operates. The attendant radio and newspaper publicity, coupled with the airplane flying overhead, makes people surprisingly forest fire conscious, especially in areas where fire permits are necessary. In this connection, I have heard a responsible State official who witnessed this phase of operation say, "The airplane is the most effective single forest fire prevention medium in effect in New York State today."

Presuppression.—Strong presuppression action, so as to catch fires when small—rather than greater suppression action, aimed primarily at keeping 10-acre fires from becoming 200-acre fires—is one of the cardinal principles of our forest fire control organization. The airplane plays a part, directly or indirectly, in most of our presuppression planning. The patrolling of State land and areas where fires are numerous, with an eye for such things as logging operations, blow-down areas, etc., helps tremendously in compiling current slash maps or maps of high fire hazard. Registration of intended cutting by lumber operators is not required in New York State, consequently many logging jobs are well under way adjacent to and outside our

forest preserve before we are aware of them. Obviously, the degree of fire hazard depends on the size of the job and its location. Slash maps and maps of high fire hazard are of major importance in planning appropriate suppression action when a fire is reported.

In remote areas of probable fire hazard the construction of proper facilities for storing fire fighting tools and housing personnel is one of our presuppression measures. Four such buildings were strategically located in our forest preserve, and we had the occassion last fall to erect another on the shore of a small lake in a very remote section. It was necessary to transport 20 tons of materials 22 miles to do this job. Twenty-three trips by plane in 3½ days moved everything. Each round trip, including loading and unloading, averaged 55 minutes. At the loading point, trucks backed up to the airplane. The unloading point was just 60 feet from where the building was erected. It would have taken a tractor and jumper, with maximum possible load, 132 days to do this job. Figuring tractor hire, labor, time, weather, etc., we determined that with our Grumman "Goose" amphibian we did this job in one-fortieth the time and at one-half the cost.

Detection.—In my opinion, the airplane will never entirely replace the highly developed tower detection system we have in New York State today. This has been borne out, not alone by our own experience, but also by the experience of the Civil Air Patrol on forest fire detection during the war. On days when visibility is definitely restricted because of haze, smoke, etc., our single-engine "Navion" is of definite value in detection. In these cases, we are able to eliminate tower guesswork by definitely establishing the location of a fire.

Reporting.—We can pinpoint the location of a fire, size it up as of that minute, and give by two-way radio pertinent information such as size, rate of spread, strength of attack needed, where water (if any) is available, location of natural barriers, etc. We can make an immediate appraisal of its probabilities and, if necessary, organize follow-up attack strength, even before the initial crews arrive at the fire.

Small smokes deep in the forest are investigated and reported. Some of these smokes demand immediate suppression action. In many cases investigation has proved these smokes to be safe camp fires, and many a forest ranger and crew has been spared the task of carrying heavy fire fighting equipment many a weary mile on a false alarm. When a ranger leaves for a fire there is no satisfactory way of knowing where he is or what's happening to him unless he is equipped with radio. Obviously then this is not alone a saving of time, money, and effort, but, just as important, that ranger, with his crew, is not "lost" at a time when, perhaps, he may be needed most.

Suppression.—Speed of attack is our keynote. It is a major factor in the progressive reduction of fire losses. In actual suppression we are able to guide the fire fighters directly to the scene of the fire, and, in many cases, direct the actual initial attack. We are able to control men and equipment at all times, whether en route or actually working on the fire line. We can concentrate all forces on one fire or divide forces to take care of several fires as the occasions and conditions warrant. All this is effectively accomplished from aircraft because of the commanding view of the situation. It has its psychological value too, because the men on the ground know that the

airplane is watching out for everything, including fires in other parts of the district. One swing around any fire and there are no loafers on the fire line.

Transportation of supervisory personnel and equipment quickly from one fire to another or from one end of the State to the other is extremely valuable, especially for large fires. As a matter of fact, we transported personnel and equipment to one 10,000-acre fire and thereby saved the lives of 15 persons. Actually, if it is a matter of equipment only, we can deliver hand tools and power pump accessories, including gasoline, by dropping them directly on the fire line. We are furthering our cargo parachute dropping project this year.

Scouting.—Reports on the current progress of any fire is of paramount importance to the men in charge on the ground. These reports can be quickly and easily made from the air. They include calculating rate of spread; informing crews of outbreaks along the fire line, etc.; locating spot fires as they occur and guiding crews to them; and, patrolling the fire after it is under control. In this latter category, it is our general practice to make early morning patrols to catch outbreaks on the line before the heat of the day has its effect.

Estimation of Burned Areas and Damage.—To say that we are able by airplane to estimate burned areas and damage usually within 5 percent may sound fantastic, but it is nevertheless true. The method of estimating is based on actual surveys on the ground. Our largest recorded error in 12 years of using this system was slightly over 6 percent on a 690-acre fire.

Any study of our modern forest fire control methods may well take into consideration the American tempo, the eternal quest for doing things quicker and more efficiently, as typified by our efforts to "streamline" our living and working conditions. This pace is reflected in our forestry practices, our watershed management, and our recreational habits. All this has a profound effect upon forest fire control. Today, we are called upon to fight fires which are directly the result of this American tempo; fires which demand of us the promptest kind of response and the use of specialized apparatus and equipment, such as high-speed water-carrying trucks, power pumps, ditch diggers, fire line constructors, airplanes, and parachutes, that might never have been dreamed of even by a "Jules Verne" of our original forest fire control organization.

The use of aircraft in forest fire control in New York State has been tried and proven. Each year adds to our experience with, and knowledge of, this use of aircraft and to our dependence on it. However, we are still not making fullest possible use of aircraft. This will be our goal in the near future. Who knows but that in the not-too-distant future foresters, even those who doubted the value of aircraft, may be directing the actual attack on a fire from behind desks 100 miles away, through the medium of aircraft, radio, and television.

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed on a strip of paper attached to illustrations with rubber cement. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the legend to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired. Do not submit copyrighted pictures, or photographs from commercial photographers on which a credit line is required.

India ink line drawings will reproduce properly, but no prints (black-line prints or blueprints) will give clear reproduction. Please therefore submit well-drawn tracings instead of prints.

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